AD-A149 773 LITTLE RIVER INLET NAVIGATION PROJECT BRUNSWICK COUNTY NORTH CAROLINA AND..(U) CORPS OF ENGINEERS CHARLESTON SC CHARLESTON DISTRICT JUN 77 1/2

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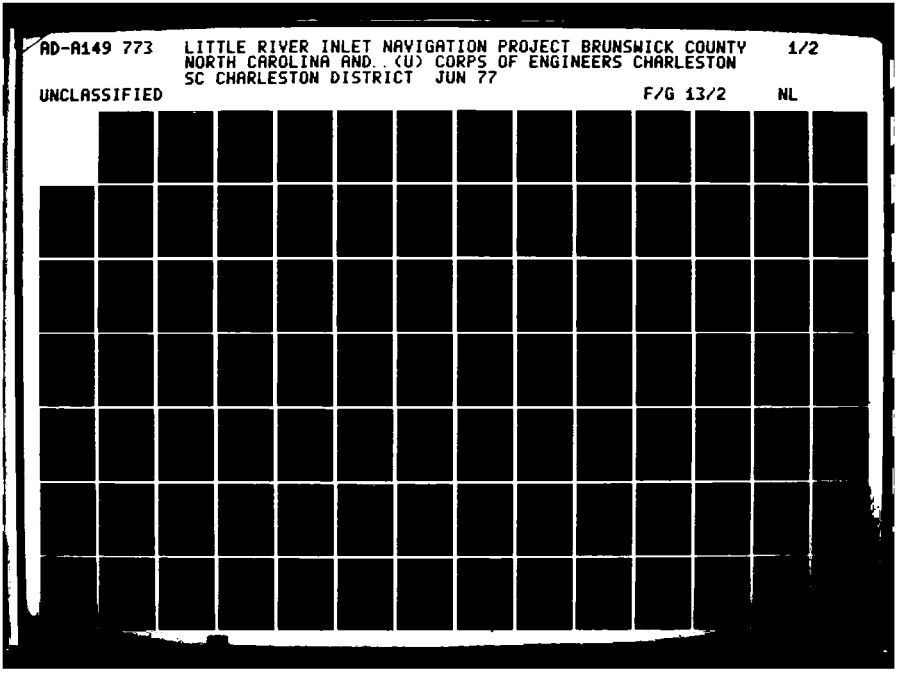
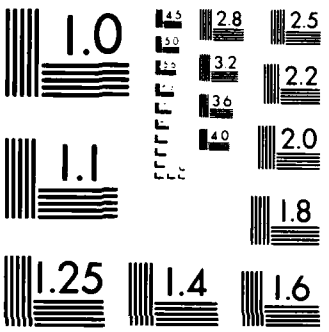




REVISED

FINAL

ENVIRONMENTAL IMPACT STATEMENT

LITTLE RIVER INLET
NAVIGATION PROJECT
BRUNSWICK COUNTY, NORTH CAROLINA
AND HORRY COUNTY, SOUTH CAROLINA

Prepared by
U. S. ARMY ENGINEER DISTRICT, CHARLESTON, SOUTH CAROLINA

June 1977

SUMMARY

Little River Inlet Navigation Project, Brunswick County, North Carolina and Horry County, South Carolina

( ) Draft (X) Final Environmental Statement

Responsible Office: U. S. Army Engineer District
P. O. Box 919
Charleston, South Carolina 29402
Telephone: 803-577-4171, Ext. 229

1. Name of Action: (X) Administrative ( ) Legislative

2. Description of Action: The recommended plan of improvement consists of the following: dredging an entrance channel, 300 feet wide and 12 feet deep through the offshore bar, a distance of approximately 5,160 feet; providing an inner channel, 90 feet wide and 10 feet deep from the entrance channel to the Atlantic Intracoastal Waterway, a distance of 11,000 feet; dredging the lower 5,200 feet of the inner channel; dredging an upcoast deposition basin adjacent to the weir section of the north jetty to a depth of -20 feet to provide a capacity of 400,000 cubic yards; dredging a downcoast deposition basin adjacent to the weir section of the south jetty to a depth of -10 feet to provide a capacity of 200,000 cubic yards; constructing a north jetty 3,835 feet long with a low weir section for sand bypassing; constructing a south jetty 3,570 feet long with a low weir section for sand bypassing; constructing sand dikes on both sides of the inlet to tie the jetties to the existing dune line; and possibly constructing a fishing walkway on top of the south jetty.

3. a. Environmental Impacts: Short-term increase in turbidity; alteration of existing vegetation during construction of south sand dike; temporary frightening of birds and mammals in the area; destruction of some benthic organisms by dredge cutterhead; smothering of invertebrates under jetty stone and in beach disposal areas; improvement of navigation with associated benefits to local economy, charter and commercial fishing industries, and recreational boaters; and increase in recreational opportunities.

b. Adverse Environmental Effects: Temporary increase in turbidity; alteration of existing vegetation during construction of south sand dike; temporary disturbance of birds and mammals in the area; destruction of some benthic organisms by dredge cutterhead; smothering of invertebrates under jetty stone and in beach disposal area; and possible displacement of wildlife species.

4. Alternatives. Alternatives to the proposed action include no action; channel improvement without structural control; modified structural controls; and alternate channel depths.

5. Comments received from:

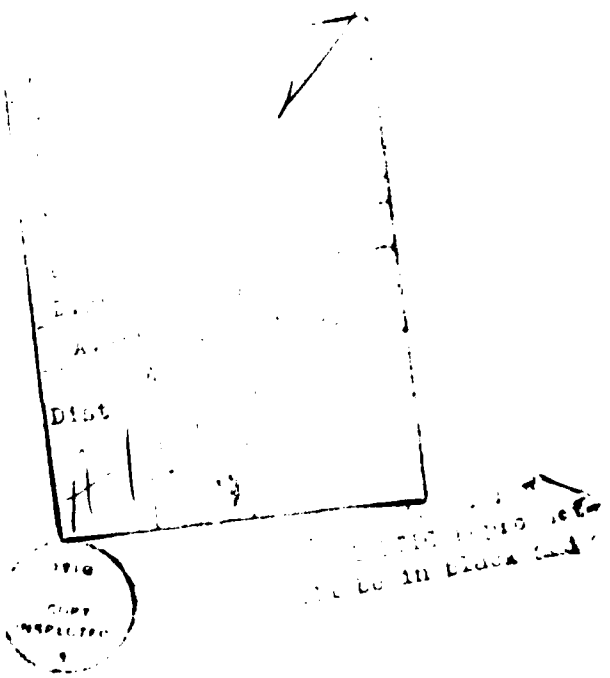
U. S. Environmental Protection Agency
U. S. Department of Interior
U. S. Department of Commerce
Forest Service, USDA
Soil Conservation Service, USDA
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Federal Highway Administration, USDT
North Carolina Office of Marine Affairs
North Carolina Department of Human Resources
North Carolina Department of Natural and Economic Resources
South Carolina Wildlife and Marine Resources Department
South Carolina Department of Health and Environmental Control
South Carolina Department of Archives and History
South Carolina Water Resources Commission
Cape Fear Council of Governments
Waccamaw Regional Planning and Development Council

6. Draft Statement to CEQ 20 January 1972.

Final Statement to CEQ 19 September 1972.

Revised Draft Statement to CEQ 30 September 1976.

Revised Final Statement to CEQ 27 May 1977.



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1.0 Project Description

1.01 Project authorization. The Little River Inlet Navigation Project (Plate 1) was authorized by the Congress of the United States on 12 October 1972 under Section 201 of Public Law 298, 89th Congress (House Document 92-362, 92nd Congress, 1st Session).

1.02 Project purpose. The purpose of this project is to provide a stabilized channel from the 12-foot contour in the open ocean to the Atlantic Intracoastal Waterway (AIWW) of sufficient depth and width for regular use by commercial and recreational vessels. The benefit-to-cost ratio (navigation facilities only) of the proposed project is 1.2:1. A summary of project economic data is presented in Appendix A.

1.03 Description of the proposed plan of improvement. The proposed plan provides for the construction of an upcoast jetty with a low weir section, a downcoast jetty with a low weir section, sand dikes (downcoast with protective berm), two deposition basins, entrance channel and inner channel. The two jetties, sand dikes, deposition basins, entrance channel and that portion of the inner channel requiring dredging are shown on Plate 2. Plate 1 shows the extension of the inner channel to the AIWW.

1.04 Upcoast jetty. The jetty would be composed of a low weir section, trunk section, and a head section. The low weir section would have a length of 1,275 feet and an elevation of 2.3 feet, which elevation would allow the passage of littoral drift moving between the shoreline and -4 foot mean low water (mlw). The low weir section would be connected to a sand dike described in Section 1.06 by a jetty section 200 feet in length, 114.5 feet at elevation 8 feet msl sloping to an elevation of 2.3 feet mlw at the juncture with the low weir section. The trunk section would extend a distance of 2,085 feet seaward of the low weir section and would have an elevation of 8 feet mlw and a crest width of 15 feet. The head section would extend a distance of 150 feet seaward from the trunk section and would be constructed to the same elevation as the trunk section. It would however be wider and would have an additional armor layer. The total length of this jetty would be 3,710 feet.

1.05 Downcoast jetty. This jetty would be similar to the upcoast jetty but differs in the following features. The length of the low weir section would be 1,310 feet and the length of the trunk

section would be 1,830 feet, giving a total length of 3,490 feet. Although the elevation of the low weir section in both jetties is the same, littoral drift patterns and shoreline configurations indicate that the low weir section in the downcoast jetty will allow the passage of littoral drift moving between the shoreline and -2 feet mlw.

1.06 Sand dikes. Sand dikes would be constructed from the shoreward end of the weirs to the existing dune line at 10 feet mlw. The upcoast sand dike would consist of strengthening (widening) an existing sand dune and extending it to the mean low water line. The length of upcoast sand dike would be about 2,330 feet. The downcoast sand dike would extend from the shoreward end of the downcoast weir to the existing high ground at elevation 10 feet mlw, a length of about 4,970 feet. The dike would have a crest width of 100 feet and side slopes of 1 vertical on 25 horizontal. The downcoast sand dike would have a berm on the bayward side at elevation 8 feet mlw between the east tip of Waties Island and the downcoast deposition basin. The berm would provide protection to the sand dike and downcoast deposition basin from high ebb tide velocities and would confine flow within the channels. The dikes would be constructed of hydraulic, granular fill dredged from the channels and deposition basins. Upon completion of construction, the sand dikes will be planted with sea oats, panic grass, beach grass, or other salt-tolerant plant species to aid in erosion control. Profiles and typical sections of the jetties and sand dikes are shown on Plate 4.

1.07 Deposition basins. Following construction of the jetties, deposition basins would be dredged between the weirs and the entrance channel with a pipeline dredge to trap littoral material moving in either the upcoast or downcoast direction over the weirs. The upcoast basin would be dredged to a depth of -20.0 feet mlw and would have a capacity of 400,000 cubic yards and the downcoast basin would have a depth of -10.0 feet mlw with 200,000 cubic yards capacity. The sides of the basins (bottom dimensions) adjacent to the weirs will be 1,125 and 1,160 feet for the upcoast and downcoast weirs, respectively; the other dimensions of the basins will be commensurate with the aforementioned basin capacities. The capacity of the deposition basins will be sufficient to contain an estimated two-year accumulation of littoral drift material.

1.08 Entrance channel. The entrance channel would extend from the -12-foot ocean contour to the inner channel, a length of about 5,160 feet. The entrance channel will be 300 feet wide and 12 feet deep. An allowable overdepth of 2 feet will be permitted to compensate for dredging inaccuracies. Side slopes of 1 vertical on 4 horizontal are expected initially after the box-cut dredging of the channel. Due to the wave action in the entrance channel, the ultimate side slope will probably be 1 vertical on 10 horizontal. The distance between the edge of the channel and the jetty toe are sufficient to allow for this ultimate side slope.

1.09 Inner channel. The inner channel would extend from the entrance channel up Little River to the AIWW, a length of 11,000 feet. Only the lower 5,200 feet of the channel will require dredging. The inner channel will be 90 feet wide and 10 feet deep. An allowable overdepth of two feet will be permitted to compensate for dredging inaccuracies. Side slopes of 1 vertical on 4 horizontal are expected after the box-cut dredging of the channel. Since there is little or no wave action in the inner channel, it is believed that this slope would be stable.

1.10 Recreation facilities. At the time of the project document, a fishing walkway was not economically justified because of the lack of access to Waties and Bird Islands which are privately owned. In addition to the foregoing, there was no expression of interest (on the part of legally responsible and financially capable state or local agencies) in participating in the construction of a jetty fishing walkway. Recently, however, the South Carolina Department of Parks, Recreation and Tourism has shown an interest in purchasing Waties Island for development as a park and would be interested in participating in a jetty fishing walkway if a state park is subsequently developed. The proposed Waties Island State Park borders on the west side of Little River Inlet. Should the South Carolina Department of Parks, Recreation and Tourism purchase the island, a fishing walkway, comfort station, and access trail could be justified. As shown in Appendix A, apportionment of first costs for recreational development would be 50% Federal and 50 State.

1.11 The recommended plan of improvement (Plate 5) would provide for a 6-foot wide bridge over the weir section and an 8-foot wide fishing walkway constructed on the downcoast jetty along its entire length; a paved access trail from the parking area to the walkway area, a parking area for the walkway and the other activities in this segment of the park area; and a toilet facility located in the general vicinity of the picnic area, as shown on Plate 5. All facilities would be designed in accordance with the latest criteria for design of facilities for handicapped persons.

1.12 Fishing walkway. The timber portion of the walkway bridging the weir would have a deck at elevation 15 feet mlw which corresponds to the 10-year frequency storm wave level. The deck would be 6 feet wide with handrails on both sides for safety. The asphalt portion of the walkway would be 8 feet wide and would extend the entire length of the downcoast rubble mound section. The downcoast jetty would be raised 1 foot for the safety of fishermen and sightseers and to make the jetty usable during spring tides.

1.13 Comfort station. The comfort station would be designed in accordance with a standard plan of the South Carolina State Department of Parks, Recreation and Tourism. This building would be compatible with the picnic shelters and other facilities of the proposed park.

1.14 Power supply. The Department of Parks, Recreation and Tourism would provide power at the transport and recreation area which would be extended to the well pump and comfort station. Power will only be needed for lighting in the comfort station and for the water and sewage pumps.

1.15 Water supply. It is estimated that about 350 persons would use the comfort station during peak weekends requiring about 10 gallons of water per person. This would amount to 2.4 gallons per minute; however, since this demand would be over an eight-hour period at least 7 gallons per minute should be provided. To meet peak demands, the system would be sized to supply at least 35 gpm for short periods of time. It is proposed to provide water with a 4-inch well located near the comfort station. The water system would consist of a well pump, a high pressure supply main to a 1,000 gallon pressure tank, a pressure switch on the pump and an air compressor and relief valve or other acceptable means for maintaining the correct air-water ratio in the pressure tank.

1.16 Sewage disposal. Domestic sewage would require about 2,400 gallons per day which is two-thirds of the total water requirement. The Department of Parks, Recreation and Tourism would be responsible for the extension the county sewer system to the transport and recreational area. It is proposed to provide a pump station (80 gallon per minute pumps) and a 4-inch diameter PVC force main to connect with the park's sewer system.

1.17 Parking. Parking would be provided for 200 cars. Based on recommended stall and aisle sizes for 90° parking (9' x 18' stalls, 27' center aisle) the lot would be 189' x 350' including the 25' end aisles. This new parking area would be adjacent to the proposed parking area and about 2 miles from the jetty. Access to the walkway would be provided by state operated vehicles or by walking to the jetty along the beach or along the trail through the forest.

1.18 Proposed dredged material quantities and placement plan. The initial amount of material to be dredged from the various reaches is as follows:

Entrance channel	440,000 cubic yards
Inner channel	170,000
Deposition basins	
Upcoast	450,000
Downcoast	230,000
Total	1,290,000

1.19 Entrance channel. Initial dredging quantities for the entrance channel are estimated to be about 440,000 cubic yards. This material is of a sandy nature and would be used for sand dike construction, beach nourishment, or both.

1.20 Inner channel. Dredging required for construction of the inner channel is estimated to be 170,000 cubic yards. This material is also of a sandy nature and would be used for sand dike construction, beach nourishment, or both.

1.21 Deposition basins. Deposition basins would be dredged between the weirs and the navigation channel to intercept and hold

material bypassing the weirs. Initial construction would require the removal of 450,000 cubic yards for the upcoast basin and 230,000 cubic yards for the downcoast basin. This material is mostly sand and would be used for sand like construction and beach nourishment.

Operation and maintenance.

Channels. The most significant aspect of operation and maintenance of this project is maintenance dredging which would be required about every two to three years. Such dredging would remove about 309,000 cubic yards of material annually at a cost of about $884,000 including the cost for mobilization and demobilization. This annual quantity includes sand bypassing of 200,000 cubic yards from the eastern deposition basin, 100,000 cubic yards from the western deposition basin and inner channel maintenance dredging of 9,000 cubic yards. Because of the flow restriction created by the jetties, the entrance channel would have sufficient tidal currents to be self-maintained and, therefore, no maintenance dredging would be needed for that channel. Material removed from the inner channel and littoral drift that has passed over the jetty-weirs and into the deposition basins would be used to stabilize adjacent shorelines. Dredging would be accomplished by pipeline dredge.

Jetties. Included under this project feature are the two jetties and sand dikes. No major rehabilitation of these structures would be required since toe protection would be provided for the jetties where scour is most likely to occur. As scour occurs, this layer of toe protection stone would drape the sand slope thereby holding foundation sands in place, preventing settlement of the rubble structure. It is estimated that the average annual cost of jetty maintenance would be $78,000. Sand dike maintenance costs are included in channel costs discussed above.

Recreational facilities. Maintenance is expected to be high since the portion of the walkway over the weir section is expected to need replacement every 15 years and the portion of the walkway over the rubble mound section would have to be replaced every 25 years. The waves breaking on the jetty may cause shifting of the stones under the walkway, causing cracking of the pavement. Large waves can also be expected to damage the wooden deck of the walkway over the weir section. No unusual maintenance is expected for the comfort station, access trail or parking lot. The South Carolina Department of Parks, Recreation and Tourism would be responsible for maintaining all recreational facilities including the walkway, comfort station, access trail, and parking lot.

Special studies. Under the aforementioned authorization, the following studies were conducted:

Environmental studies: Environmental studies were accomplished under a contract with the South Carolina Wildlife and Marine Resources Department. The study was designed to:

a. Provide an estimate of the biological productivity of the area with a view to preventing or minimizing any adverse project effects on biological systems.

b. Provide a basis for an assessment of changes in biological communities during and following construction of this and other similar projects.

1.28 Model study. A fixed bed model of the Little River Inlet system was constructed at the Waterways Experiment Station (WES) in Vicksburg, Mississippi to examine the effects of currents and wave conditions on different arrangements of project appurtenances under simulated prototype conditions. WES presented ten jetty alignments for preliminary testing. A brief description of these plans and the results of this testing is as follows:

a. Plan 1A. Similar to the project plan, but normal to the shoreline. This plan crosses the shallow ocean bar on the downcoast side of the inlet. Flow lines are generally good, however, ebb velocities in the entrance channel and along the upcoast sand dike and basin area are rather high. Peak ebb velocities between the jetties varied from 4.0 to 5.0 feet per second (fps). Flood velocities varied from 3.5 to 4.5 fps.

b. Plan 1B. Same as 1A with weir in the upcoast jetty. Ebb velocities in the area of the upcoast weir are still rather high. Early flood flow is similar to Plan 1A. Once the tide is above the top of the weir, there is flow over the deposition basin. Maximum flood flows are 4.0 to 3.5 fps. Maximum ebb velocities range from 4.2 to 5.3 fps between the jetties.

c. Plan 1C. Same as 1A with weir in the downcoast jetty. Flow is similar to 1A, however, velocities along the upcoast weir are slightly less. During early ebb, flow is over the weir section, but once the water level is below the weir crest, it is confined to the channels.

d. Plan 1D. Same as 1A with weirs in both jetties. Flow is similar to 1A, however, velocities along the upcoast weir are slightly less.

e. Plan 2A. The jetties are moved upcoast with respect to Plan 1A still normal to the shoreline but now follow the existing channel through the ocean bar. Ebb velocities in the channel are slightly slower than Plan 1, but now the downcoast sand dike and jetty is subjected to high velocities.

f. Plan 2B. Same as 2A with a weir in the upcoast jetty. Flow is similar to 2A except that some flood flow is deflected towards the downcoast sand dike.

g. Plan 2C. Same as 2A with a weir in downcoast jetty. Flow is similar to 2A including high velocities along the downcoast sand dike.

h. Plan 2D. Same as 2A with a weir in both jetties. Flow is similar to 1A but during the early ebb, flows attack the bend in the upcoast rubble mound jetty.

i. Plan 2D1. Same as 2D but with shortened jetties and berm on downcoast sand dike. Flow is similar to Plan 2D.

j. Plan 3. This is the same as the project plan presented in the survey report. Flow patterns are fairly good between the jetties.

1.29 A review of the photographs shows that Plans 2D and 2D1 were better than the other plans. The problem of any high velocities along the downcoast sand dike would be alleviated by filling the area adjacent to the downcoast basin to a level above the high water mark with excess excavated material from the basins and channels. Plan 2D and 2D1 are also less costly than Plans 1 or 3. For Plans 1 and 3 ebb and flood velocity direction are reversed bayward of the upcoast sand dike compared to the base plan. For Plan 2, bay circulation remains closer to the natural condition. Wave tests indicate that wave heights are lower in the entrance channel for Plan 2 than for Plans 1 and 3. The wave tests consist of seven second waves with wave heights of 4.8 feet generated from the east and southeast. Shoaling tests also have been performed and indicate that the weir and deposition basins will operate very efficiently. The complete results of the model tests are not available in report form. However, Plan 2D1 is the selected plan based on the detailed model testing.

1.30 Monitoring of project effects. Constructing jetties at Little River Inlet would likely have some effect on adjacent beaches. In order to identify changes which might be attributed to project construction, a monitoring program would be undertaken at an annual cost of $14,000 as part of the project. This program would cover a minimum 10-year period after project completion and would monitor both existing and future geographical features in addition to project features and structures. A summary of the project monitoring plan follows.

SUMMARY OF LITTLE RIVER INLET PROJECT MONITORING PLAN

Item	Extent	Frequency
HYDROGRAPHIC SURVEYS:		
Deposition Basin	Whole Basin	Annual
Entrance Channel	Entire channel	Annual
Interior Channel	Entire channel	Biennial
Outer Bar	2000 feet on each side of jetties 1000' seaward	Once during the 1st 5 years
LAND SURVEYS:		
Sand Fillet & Profiles	Parallel & 500' from jetties to MLW line	Semi-annual for 1st 3 years; then annual
Beach Profiles	7 along east beach 7 along west beach	Annual
Jetty, levels	Both jetties	Biennial
PHOTOGRAPHS:		
Aerial	Little River Inlet) Mad Inlet) Tubbs Inlet) Hog Inlet) Shallotte Inlet)	Annual Continuous (include intervening area)
Jetty	Both jetties	Annual
SAND SAMPLING:		
Deposition Basin	10 surface samples	Annual
Entrance Channel	5 surface samples	Annual
Interior Channel	10 surface samples	Annual
Outer Bar	10 surface samples	Annual
Beach Nourishment Areas	10 surface samples for each area	Only when sand is being placed, near end of the nourishment
Sand Fillets at Jetties	6 surface samples	Semi-annual for 1st 3 years; then annual
Beach Profiles	112 surface samples	Annual

2.0 Environmental Setting Without the Project

2.01 General. Little River Inlet is a shallow coastal inlet located in Brunswick County, North Carolina and Horry County, South Carolina (see Plate 1). Little River originates in Little River swamp and flows generally eastward, entering the Atlantic Ocean at Little River Inlet between Waties Island and Bird Island. The inlet provides an ocean entrance to the AIWW and to several tidal streams in the Little River, South Carolina - Calabash, North Carolina estuarine area. The Little River Inlet estuarine system is characterized by high energy ocean beaches, sand and mud flats, intertidal shellfish beds, and expanses of salt and brackish water marshes intersected by numerous tidal streams. The inlet is constantly shifting due to ocean currents and wave action resulting in a situation which is hazardous to navigation.

2.02 History of Little River Inlet shoaling problem. Principle difficulties attending navigation result from inadequate depths across the ocean and inner bars and continual shifting of the bar

channel. Channel alignment shifts so rapidly and so often that it is difficult for the Coast Guard to maintain channel markers in proper positions. During periods of low tide or of high seas or swell, the bars are extremely hazardous if not impassable. This condition has created an unstable channel without adequate depths to permit unrestricted navigation through the inlet and offshore bar. To help alleviate this condition, emergency dredging under the River and Harbor Act of 1945 was performed at Little River Inlet in August 1967 when an 8 x 100-foot cut was made through the inner bar for a distance of 1,200 feet. During November of 1968, emergency dredging was performed at the entrance (ocean bar) to provide a channel 10 x 100 feet for a distance of 2,600 feet. These dimensions were not actually achieved and the channel soon deteriorated further.

2.03 In 1974, Congress included in P.L. 93-251 a provision which directed the Corps of Engineers to perform emergency dredging operations needed to maintain channel depths sufficient to permit free and safe movement of vessels as an interim measure until the authorized project is constructed. Emergency dredging under this authority has been accomplished as follows:

a. The inner channel was dredged by pipeline dredge to a bottom depth of 8 feet mlw and a bottom width of 100 feet between 29 May 1974 and 9 June 1974.

b. The outer bar was dredged by the Corps-owned sidecaster dredge MERRITT to a depth of 10 feet mlw and a bottom width of 100 feet between 31 March 1974 and 30 April 1974.

c. During the period 28 April 1975 and 15 May 1975 the Corps-owned sidecaster dredge MERRITT attempted to dredge an 8 x 100-foot channel through the outer bar for a distance of 1,500 feet.

d. The most recent dredging occurred in March and April, 1976. During this period the Corps-owned sidecaster dredge FRY attempted to dredge a 3,400 by 8 by 100-foot channel through the outer bar and a contractor owned pipeline dredge removed 107,836 cubic yards of material from a 4,000-foot section of the 6 by 100-foot inner channel.

2.04 Emergency dredging of the outer bar is accomplished by the only practicable equipment capable of working in such shallow inlets without damage to itself - Corps-owned sidecaster dredges. However, this equipment is inefficient in obtaining desirable depths, and complaints of inadequate depth are received within a week or two of its departure. In short, the emergency dredging of the channel is considered to be an inadequate alternative to stabilizing the inlet channel by jetties.

2.05 Other Federal projects. The Cape Fear River, about 32 miles upcoast, is the nearest Federally improved inlet to the north. The nearest Federally improved harbor on the downcoast is Georgetown

Harbor, South Carolina, about 56 miles away. Murrells Inlet, South Carolina is about 35 miles from Little River Inlet. This inlet has a severe shoaling problem with a normal controlling depth of about 3 feet, mean low water. The Murrells Inlet Navigation Project (similar to the Little River Inlet Project) is in the final stages of preconstruction planning. The Federally maintained Atlantic Intracoastal Waterway is located at the upper end of the proposed project.

2.06 Regional physiography and geology. The project lies along the eastern edge of the Atlantic Coastal Plain Physiographic Province. This province is underlain by sediments of Cretaceous to Recent Age which become thicker in a southeastern direction from the Fall Line. Little River Inlet lies along the central axis of a northwest trending structural high known as the Cape Fear Arch (originally known as the Great Carolina Ridge). This arch is thought to have begun flexure in Late Eocene time and to have continued to rise until late Miocene. Sediments younger than Miocene are essentially flat lying whereas older sediments dip slightly away from the axis of the arch. In the central part of the arch, erosion has removed most of the Tertiary sediments exposing Paleocene to Upper Cretaceous formations below a thin cover of late Tertiary to Recent sediments (see Plate 6).

2.07 The barrier islands, such as Bird and Waties Islands, are geologically very young, having been formed during Pleistocene to Recent time. Bird Island, located upcoast of the inlet is somewhat less typical of barrier islands than Waties Island, which is located downcoast of the inlet. Bird Island has an average width of 1,000 feet and is low topographically, with very low, arcuate, northeast trending dune ridges being the dominant feature. Waties Island is larger and wider and has a more well developed typical geomorphic expression, with beach environment, hummocky dune ridges with scrub vegetation, and a backdune flat.

2.08 Shallow borings taken in the inlet all found similar sands down to a depth of 25.5 feet where they were terminated. The sands were generally gray, fine to coarse grained, with varying amounts (up to 30%) of shell fragments, occasional minor clay beds, and areas containing minor (less than 5%) heavy minerals. The sands contained occasional wood fragments, and were generally quite uniform in grain size, color and texture. The sands were dense to very dense with average blow counts (standard penetration test) above 30 and with blows above 50 being common in the lower depths. The blows tended to increase with depth in the shallow borings. Two deeper borings found a lessening of density (decrease in blow count) and an increase in shell content at a depth of about 35 feet. This was about four feet above the contact with the underlying siltstone and shale. The siltstone-shale was found to be relatively soft in the first deep boring (low blows N=27) while this same interval in the second had very high core losses. The 39-foot depth appears to be the depth of scour of the present inlet.

[illegible] material above this depth is reworked sediments. The limestone and [illegible] represents the Black Mingo Formation of Paleocene age. The limestones encountered were approximately 1 foot or less in thickness, silty and generally hard. They were generally fine grained and not highly fossiliferous. Thin limestone beds were found at the point of refusal in both deep borings. As noted above, the 39-foot depth appears to be the limit of recent scour; nearly all material above this [illegible] point consisted of similar gray sands. Shoreline change studies indicate that the inlet has occupied the area in which these borings were taken during shifts in the very recent past. All the sands above the 49-foot depth are of Pleistocene to Recent Age, most of them being of Recent Age.

2.09 Soils. The materials forming the beaches in the project area consist chiefly of silica sand, but locally, shell fragments are abundant. On most beaches a thin bed of peaty clay or sand crops out near mean sea level. This layer is commonly covered except immediately after storms and is more resistant to erosion than the beach sands. Peat is exposed at several places along the beach. Soils in the Little River Inlet area belong to the Capers and Wando-coastal beach associations (Craddock and Ellerbee).

2.10 Capers association. Capers soils are deep, poorly drained, nearly level soils on tidal flats and are flooded almost daily by salt-water tides. These soils have very dark grayish-brown to dark gray silt loam to clay surface layers and gray to greenish-gray silt clay loam to clay subsoils. Soils in this association contain a high percentage of organic material and are not suitable for dry land agriculture.

2.11 Wando-coastal beach association. This association contains deep, excessively to well-drained, gently sloping to nearly level soils which have developed in thin beds of sands. These soils occur as a broad, nearly level area between the Waccamaw River and the ocean and as sand dunes and beaches bordering the ocean. Wando soils and coastal beach make up 55 and 35 percent of this association, respectively. The remaining 10 percent is made up of Lakeland, Rutledge, and Capers soils.

[illegible] Wando soils are excessively drained and occupy a long [illegible] strip of land paralleling the coast just behind the sand dunes [illegible] the beaches. They have dark grayish-brown fine sand surface [illegible] and strong brown fine sand subsoils. Coastal beach consists of [illegible] and dunes occupying a narrow strip of land bordering the Atlantic Ocean.

2.12 Little River Inlet sediments. Table 1, which is a resume [illegible] soil test results, shows that the greater portion of the subsurface materials encountered at Little River Inlet are poorly graded fine silty sands. With the exception of the more plastic soils found at [illegible] greater than 36 feet in borings No. LR-1 and No. LR-13 (see Plate [illegible] the grain-size breakdown of all the soils tested is as follows:

4.8
1.2
3.2
0.4
0.4

[illegible] indicate that, in most cases, a [illegible] was reached within the first foot [illegible] there is the expected general increase in depth. In a more recent [illegible] collected with a modified Petersen dredge [illegible] in Little River (see Plate 7). Sediment [illegible] in the entrance channel and stations LRI-1 [illegible] were mostly gray or light gray poorly [illegible] stations LRI-5, LRI-7, and LRI-9 further up [illegible] primarily composed of gravel-size shell fragments [illegible] sand. Grain size analysis data are presented in [illegible] Chemical analyses of these sediment samples did not reveal [illegible] amounts that would adversely affect water quality during [illegible] disposal operation (see Table 2).

[illegible] littoral drift. When waves approaching the shoreline at [illegible] not completely refracted, the breaking waves create a [illegible] littoral current. This current is more apparent in the [illegible] than farther out. It carries the beach sand, which [illegible] put into suspension by the turbulence of the breaking [illegible] in a shore parallel to the beach. The sand, which is moved [illegible] is known as littoral drift. The term "net littoral drift" [illegible] the difference between the volume of sand moving in one direction [illegible] beach and that moving in the opposite direction. At [illegible] the predominant direction of littoral drift is in [illegible] direction. Based on the latest available [illegible] annual littoral drift rates for the Little River [illegible]

[illegible] drift	300,000 cubic yards
[illegible] material	200,000 cubic yards
[illegible] material	100,000 cubic yards
[illegible] littoral drift	100,000 cubic yards

[illegible] Little River from 1873 to 1968 are [illegible]

[illegible] water. There are three geologic formations in the [illegible] ground water aquifers, the Tuscaloosa, Black Creek, [illegible] (36). Most of the well water along the Grand Strand [illegible] Creek and Peedee formations. The Black Creek [illegible] chiefly of dark-gray laminated clay and sand. Water [illegible] formation is soft, highly mineralized, and contains [illegible] bicarbonate. Many flowing wells in Georgetown and [illegible] their water from this formation. The Peedee for[illegible] gray sandy marl interbedded with thin ledges of

[illegible]stone. Waters in this formation are soft and contain considerable [illegible] bicarbonate. The Tuscaloosa formation contains a great deal of [illegible] through which water can circulate freely and as a result is one of the most productive water bearing formations in the Coastal Plain. Water derived from the Tuscaloosa formation is soft and only moderately [illegible] alized.

[illegible] Surface water. The Little River Inlet system conforms [illegible] Pritchard's (1955) definition of an estuary as "a semi-enclosed coastal body of water having a free connection with the open sea and within which the seawater is measurably diluted with fresh water runoff." Low salinity water enters the inlet area via AIWW and despite mixing processes, some stratification occurs. As can be seen in Table [illegible], stratification was observed at station LRI-9 (see Plate 7) during an April 1976 study by the South Carolina Marine Resources Center. It should be noted, however, that this study was conducted during a rather extensive drought and salinities may have been somewhat higher than normal.

[illegible] The Marine Resources Center found pronounced oscillations [illegible] salinity over a tidal cycle in Little River Inlet and as a result, the estuary is regarded as poikilohaline. During high tide, relatively clear, greenish ocean water is present throughout the lower portion of the inlet. In contrast, the entire estuary is occupied by turbid, brownish-colored water of substantially lower salinity at low tide. The Marine Resources Center found that bottom salinity samples taken [illegible] from low to high tide at station LRA-3 on 22 April 1976 varied [illegible] minimum of 23.95 parts per thousand (o/oo) to a maximum of 32.97 [illegible]. Such highly variable conditions of salinity have a pronounced effect on the species composition of benthic communities in estuaries [illegible]i, 1954; Dahl, 1956; Boesch, 1976; Calder, 1976).

[illegible] Tides. The AIWW enters Little River about 2.4 miles [illegible] the mouth of Little River Inlet. At a point one mile above the [illegible]th, the mean tide range is 4.5 to 4.7 feet and the spring range [illegible] to 5.4 feet (the spring tide is the tide which rises highest [illegible] falls lowest when the earth, sun and moon are aligned). At the [illegible] of Little River, the mean tide range is 4.4 feet and the spring [illegible] is 5.3 feet. Some of the highest observed storm tides in the [illegible] were produced by hurricane Hazel on 15 October 1954. At Cherry [illegible] Beach, roughly on the ocean fronting the town of Little River, a [illegible] highwater mark of nearly 17.0 feet above mean sea level was [illegible]ved; at the town of Little River a tide level of about 16.5 feet [illegible] mean sea level is estimated to have occurred.

[illegible] Water quality. Water quality in the study area is con[illegible]ered to be fair to good. Recent water quality data collected and [illegible]zed by the S. C. Marine Resources Center as part of a contract with [illegible] U. S. Army Corps of Engineers is presented in Table 3. The lowest [illegible]ved value observed was 6.5 mg/l in a bottom water sample from station

LRI-1. Since there is no industrial pollution in the area, pollution problems are mainly related to bacterial contamination from improperly treated domestic wastes. As a result of this problem most of the area has been closed to shellfishing. In South Carolina, the Department of Health and Environmental Control has closed the area starting at Little River Inlet and including all of Little River as far as shellfish may grow, including the AIWW to the North Carolina State line and including parts of Dunn Sound to a point southwest of the bridge to Waties Island. In North Carolina, the Department of Natural and Economic Resources has closed the Calabash Creek area and the AIWW and contiguous waters upstream to just above the Sunset Beach bridge.

2.20 Climatology. The climate of the area is temperate and is moderated by the nearness of the ocean and the Gulf Stream. Although summers are warm and humid, temperatures of 100°F or higher occur on the average of less than once a year. The mean annual temperature is about 64°F. The frostfree growing season averages about 231 days. The first freeze generally occurs around the first part of November and the last freeze near the end of March. Precipitation is well distributed throughout the year with an average of about 50 inches. Percentage of precipitation by seasons is as follows: 18% winter; 20% spring; 41% summer; and 21% fall. Low pressure areas moving northeast along the coast bring heavy amounts of rain but rarely snow during the winter months. During the late summer or fall months, hurricanes occasionally reach the South Carolina coast. Available records indicate that over 70 storms and/or hurricanes have struck the coast. Heavy precipitation usually occurs with these storms, i.e., more than eight inches of rainfall associated with the hurricanes of September 1924 and October 1964 were recorded at the Georgetown weather station located about 56 miles south of the project.

2.21 Biological resources.

2.22 General. For the purpose of this report, biological resources will be separated into distinct assemblages of plants and animals called biotic communities. In general, biotic communities may be identified on the basis of their dominant vegetation or, in the absence of dominant vegetation, by physiography. Nine major biotic communities have been determined as being present within one or two miles of the project. These are:

Coastal fringe communities
- Beach
- Dune
- Pine forest
- Maritime shrub thicket

Coastal plain communities
- Oak-pine forest

Estuarine Communities
- Open water
- Tidal marshes
- Sand and/or mud flats
- Dredged material islands

Each of the biotic communities described in the following sections contains a description and/or list of characteristic plants and animals. References used to compile these are as follows:

Plants - Radford et al. 1968; S. C. Wildlife and Marine Resources Department 1976; Teal and Teal 1969.

Birds - Robins et al. 1966; Pough 1951.

Mammals - Burt and Grossenheider 1964; Palmer 1954.

Reptiles and Amphibians - Conant 1958; Carr and Goin 1955.

Fish - Breder 1948; Carr and Goin 1955; American Fisheries Society 1970; Cupka, 1972.

Invertebrates - Morris 1951; Gosner 1971; Miner 1950; S. C. Wildlife and Marine Resources Department 1976.

Beach. Beach communities in the area are found along Edisto Island northeast of the inlet and Waties Island to the southwest. The beach community is comprised of a dry berm zone located beyond the high tide line, an intertidal zone that is alternately covered and exposed by tidal action, and a subtidal zone that occurs below the low tide line and extends seaward, merging with the ocean surf. Beaches, in general, are gently-sloping communities that serve as transitional areas between open water and upland terrestrial communities.

The beach community is a harsh environment characterized by rapid changes in most of its physical environmental parameters. This is particularly true of the upper surface layers. Vascular plants are absent from these communities primarily because of instability of the substrata, high salinity, and extreme fluctuation of moisture. Fruits, and seeds of Caribbean and European plants carried by the Gulf Stream are sometimes tossed up on the beach following the passage of storms. Sediments on the beach are stratified by wind and wave energy according to particle size and are composed of fine to fine grained quartz sands and shells and shell fragments.

Macroinvertebrates are the predominant faunal organisms within the beach region and most live beneath the sand surface where moisture and temperature are most constant. Organisms in these areas are periodically subjected to strong wave and current action, the rise and fall of tides, shifting sediments, heavy predation, and wide fluctuations in temperature and salinity. Under such rigorous environmental conditions, the fauna is specialized and highly adapted for survival. A considerable portion of these organisms are filter or deposit feeders which congregate in the intertidal zones where there is a supply of organic matter brought in by the tides or by the deposition of animals on the beach.

2.27 Relatively few species inhabit sandy beaches, but those present frequently occur in large numbers. Consequently, high energy beaches are far from being biological deserts, and together with the associated fauna they act as extensive food-filtering systems (Riedl and McMahan, 1974). Typical beach inhabitants are beach fleas and ghost crabs in the beach berm; Florida conquinas, mole crabs and various burrowing worms in the beach intertidal zone and blue crabs, horseshoe crabs, sand dollars and numerous clams and gastropod mollusks in the beach subtidal areas. In addition, several species of fish are commonly observed in the surf zone along the beach, many of which are of importance to the sport and commercial fisheries of the state. The Atlantic silverside, bay anchovy, Florida pompano, Gulf Kingfish, striped mullet, rough silverside, striped killifish, striped anchovy, permit, bluefish, red drum, and planehead filefish are the most common. These species are also considered to be part of the open water community discussed in Section 2.38.

2.28 The beach zone is also utilized by many species of shorebirds for nesting and feeding. Species commonly observed are the American oystercatcher, plovers, willet, sandpipers, lesser and greater yellowlegs, gulls, and terns. Atlantic loggerhead sea turtles utilize South Carolina beaches for nesting purposes during the summer months.

2.29 In April 1976, the S. C. Wildlife and Marine Resources Department (SCWMRD) under a contract with the U. S. Army, Corps of Engineers, conducted studies of the macroinvertebrate communities in the project vicinity, including those in the intertidal beach zone. Samples of the intertidal macrofauna on Waties Island and Bird Island adjacent to the inlet were collected at stations located at high tide, mid-tide and low tide levels along a transect (Plate 7) on each of the two beaches. Analysis of these samples by SCWMRD showed that the existing communities are typical of those found along high energy beaches. Both species richness and diversity of benthic invertebrates were low. As shown in Table 4, haustoriid amphipods and the coquina clam, Donax variabilis, accounted for 98.4% of the macrofauna observed on Waties Island beach, and 85.8% on Bird Island beach. In each case, substantially fewer individuals and species were found at high tide than at mid or low tide.

2.30 Dune. Dunes are located landward and run parallel to beach communities. They are composed of drifting sand and their height and direction of movement is determined by wind direction and intensity. Few species of plants are capable of tolerating the harsh environment of the dune community. As a result, vegetative cover is usually sparse and consist predominantly of salt-tolerant perennial grasses. Typical species include Russian thistle, seabeach orach, bitter panic grass, saltmeadow cordgrass, sea oats, and broomsedges. All of these plants depend on the constant influx of nutrients because leaching in the dune community is very rapid. Likewise, all of the above species derive nutrients from particulate matter attached to the sands and precipitation. As they accumulate sand at their base, the plants increase the

...sparsely interspersed
...clumps of sea rocket, sand-
..., evening primrose, seaside elder,

...not of sufficient food
...important wildlife habitat. Ghost
..., savannah sparrows,
..., eastern glass lizards and Eastern
...faunal inhabitants. Black
...seasonally utilize the dune communities
...spring and summer.

...Scrub thickets are typically
...These communities are char-
...that are usually entangled
...unity usually begins abruptly on the dune
...only protected but they become pro-
...distance inland. The tops of the
...by wind-borne salt spray and form a
...Salt spray shearing is most evident on
...substrates in these habitats consist of
...intermittently flooded in low swale areas
...higher elevations. Typical shrub
..., bayberry, silverling, seaside elder, winged
..., black-cherry, live oak, red cedar, and hercules
...and frequency of occurrence in any
...to substratum moisture and degree of
...species in these communities are
..., greenbriers, and wild grapes. Few her-
...ground surface due to the shading
...and evergreenness of most shrub

...northward, the maritime
...the beach zone because erosion
...thicket is gradually
...waves continue to shift the
..., the maritime shrub thicket
...land

...provide a significant
..., because of this, are not
...be observed in this com-

...Red-winged Blackbird
...Boat-tailed Grackle

Birds (continued)

Brown Thrasher	Fish Crow
Gray Catbird	Indigo Bunting
Common Yellowthroat	Seaside Sparrow
White-throated Sparrow	

Mammals

Eastern Cottontail	Cotton Mouse
Raccoon	White-tailed deer

Reptiles and Amphibians

Northern Black Racer	South Toad
Six-lined Racerunner	Fowler's Toad

2.35 Pine forest. The pine forest community occurs landward of the maritime shrub community on Waties Island. The pine forest differs dramatically from the dunes in both physical conditions and living organisms. The relatively cooler, moist, organic soils support plants which prefer mesic conditions. The dominant species, slash pine, was first introduced to the island in 1950 after hurricane Hazel had destroyed the then dominant loblolly pines. Other trees found in the pine forest are red maple, red cedar, sweet gun, red bay, sugarberry, swamp willow, and black cherry. Common vines include sand bamboo, saw greenbrier, yellow jessamine, dewberry, catbrier and poison ivy. There are also several open areas in the pine forest on the northern portion of the island where sand dunes up to 15 feet in height are found. These dunes support vegetation similar to that found along the beach and were formed when cover vegetation was removed from the island after hurricane Hazel. Before the slash pine became sufficiently established to provide cover, shifting sand from the beach and the open dunes along the oceanfront was swept inland toward the marsh where it accumulated to form the dunes.

2.36 Birds are the most conspicuous faunal inhabitants of the pine forest. This is particularly true during the spring and fall when numerous migratory species are present. Representative vertebrate species found in these communities in the project area are as follows:

Birds

Red-tailed hawk	Flicker
Red-shouldered hawk	Yellow-throated vireo
Mourning dove	Red-eyed vireo
Yellow-bellied sapsucker	Parula warbler
Red-bellied woodpecker	Myrtle warbler
Pileated woodpecker	Yellowthroat
Blue jay	Red-winged blackbird
Carolina wren	Boat-tailed grackle
Mockingbird	Cardinal
Gray catbird	Indigo bunting

Birds (continued)

Brown thrasher
Robin
Cedar waxwing
Rufus-sided towhee
White-throated sparrow

Mammals

Virginia opossum
Gray fox
Gray squirrel
Raccoon
Cotton rat
White-tailed deer
Marsh rabbit
Rice rat

Reptiles and Amphibians

Green anole
Eastern glass lizard
Southern five-lined skink
Eastern coachwhip
Rough green snake
Scarlet kingsnake
Southern copperhead
Scarlet snake
Yellow rat snake
Southern toad
Oak toad
Green treefrog
Squirrel treefrog

2.3/ Oak-pine forest. The oak-pine forest communities occupy the higher sites and are generally found a short distance inland of the inlet. Soils in these areas are excessively well drained and are subject to severe leaching. A thin layer of leaves and pine needles and cones is often intermittently present on the ground surface. Live oak, water oak, and loblolly pine are the dominant tree species in these communities. The short tree or shrub region generally is a mixture of turkey oak, overcup oak, scrubby post oak, blackjack oak, and wax myrtle. Other trees present in this association are dogwood, magnolia, black willow, mockernut hickory, yellow poplar, and sweetgum. The understory includes such species as wild black cherry, sassafras, persimmon, various blueberries, laurel cherry, and herbs such as wiregrass, muhlenbergia, goldenrod, aster, partridge berry, Spanish moss, mistletoe, poison ivy, and catbrier. Animal species found in this association include:

Birds

Cooper's hawk
Red-tailed hawk
Turkey vulture
Black vulture
Bobwhite
Mourning dove
Screech owl
Chuck-will's widow
Common flicker
Red-headed woodpecker
Eastern kingbird
Eastern phoebe
Blue jay
Common crow
Fish crow
Carolina chickadee
Brown-headed nuthatch
Mockingbird
Eastern bluebird
Loggerhead shrike
Pine warbler
Yellow-throated warbler
Summer tanager
Rufus-sided towhee

Mammals

Virginia opossum	Eastern gray squirrel
Least shrew	Eastern fox squirrel
Eastern mole	Gray fox
Eastern cottontail	Striped skunk
Southern flying squirrel	White-tailed deer
Raccoon	

Reptiles and Amphibians

Northern fence lizard	Southern crowned snake
Six-lined racerunner	Eastern diamondback rattlesnake
Southeastern five-lined skink	Southern toad
	Oak toad
Eastern slender glass lizard	Pine woods treefrog
Eastern hognose snake	Barking treefrog
Eastern coachwhip	Carolina gopher frog

2.38 Open water. The open water community, as defined here, includes all marine and estuarine waters together with all underlying bottoms below the intertidal zone. The open water biota includes the plankton and nekton inhabiting the water column and the benthos living on or in the substrata.

2.39 The plankton is mainly composed of unicellular algae, larval stages of many fish and invertebrates and the adult stages of several microscopic invertebrates. Adult stages of several macroinvertebrates such as jellyfish (Chrysaora, Cyanea, Stomolophus, Rhopilema,) and comb-jellies (Mnemiopsis) which are carried by current and tides are also an important part of the plankton community.

2.40 Nekton. Fish are the principal nektonic species although some crustaceans such as portunid crabs, penaeid shrimp, and some mollusks, such as the squid spend at least a portion of their life as nekton. A number of the fish species including many of importance to the sport and commercial fishery are considered to be estuarine dependent and utilize the coastal estuaries for at least a portion of their life cycle.

2.41 Benthos. The benthic environment includes a number of communities correlated largely with substratun type. Multicellular green, red, and brown algae, and unicellular algae (especially diatoms), are the primary producers within the photic zone of the benthic environment.

2.42 The benthic fauna is divided into two groups: epifauna, living on the substratum; and infauna, living within the substratum. Infaunal communities are dominated by a great diversity of burrowing and tube dwelling crustaceans (e.g. amphipods), polychaete worms, and by

burrowing bivalve mollusks. Some infaunal invertebrates, especially among the crustaceans, are capable of a high degree of lateral mobility, but the majority are essentially sedentary. The infauna is, with rare exception, comprised of filter and detritus feeding invertebrates.

2.43 The epifauna contains a diversity of animal groups associated with a diverse flora. Hard substrata, such as rocks, shell and gravel surfaces, and artificial surfaces, such as pilings, wrecks, and weirs support a rich assortment of attached plants and invertebrates. Typically, these communities contain red, green, and brown algae, barnacles, attached bivalves, anemones, corals, sea fans, bryozoans, tunicates, sponges, and foraminiferans. The communities formed by these attached organisms host a number of both transient and permanent fish species, and motile invertebrates, including gastropod mollusks, starfish, sea urchins, crabs, and shrimp. Attached epifaunal invertebrates are principally filter and detritus feeders, but some of the more motile organisms are carnivores.

2.44 The epifauna and flora of muddy and sandy bottoms tend to be much lower in diversity, and most inhabitants are microscopic. These surfaces are unsuitable for attachment by sessile invertebrates. In addition, sand bottoms such as those found in the inlet are depositional and the continual rain of sediment quickly buries attached animals. Thus, these substrata support diatoms, other unicellular algae, protistans, and attached multicellular algae. Invertebrates primarily include motile deposit feeders, such as polychaete worms, sea cucumbers, and sand dollars. Some fish and crabs also graze on the bottom. Attached organisms are restricted largely to the occasional bit of shell or small rock lying on the surface. The development of oyster reefs on muddy intertidal bottoms, for example, is dependent on the presence of bits of shell or rock for initial larval attachment.

2.45 Benthic macroinvertebrate studies. The most extensive study of the benthic macroinvertebrate communities in the project area was recently completed by the South Carolina Wildlife and Marine Resources Department under the previously discussed contract with the Corps of Engineers. Field samples for this study were collected at 20 stations within the Little River system (Plate 2) during the period 19-22 April 1976. Sampling equipment utilized included a modified Petersen grab sampler and a modified oyster dredge. Station depths are shown in the following text table. A discussion of the findings of this study is presented in the following paragraphs.

Station	Depth (Feet)	Station	Depth (Feet)
LRI-1	14.8	LRE-2	11.5
LRI-2	9.8	LRE-3	9.8
LRI-3	14.8	LRA-1	16.4
LRI-4	13.1	LRA-2	8.2
LRI-5	16.4	LRA-3	4.9
LRI-6	21.3	LRA-4	4.9
LRI-7	18.1	LRA-5	13.1
LRI-8	11.5	LRA-6	14.8
LRI-9	13.1	LRA-7	11.5
LRE-1	19.7	LRA-8	6.6

[illegible] species [illegible] the benthic
[illegible] entrance channel [illegible]
[illegible] suitable for the attachment of
[illegible] stations (LRE-1 and LRE-2),
[illegible] sandy bottom and polychaetes were
[illegible] species diversity were high at these
[illegible] and [illegible] low diversity.
[illegible] the pattern is caused
[illegible] Nephtys longisetosa and
[illegible] characteristic of dynamic sandy sub-
[illegible] dominant organisms at this station. Few
[illegible] collected at these stations.

Inner channel. The bottom at inner channel stations
[illegible] is mostly fine sand, with relatively little shell. The
[illegible] at station LRE-3, with large numbers of
[illegible] tubicolid amphipods. Neohaustorius schmitzi, Parahaustorius
[illegible] Leptocheirus dytiscus accounted for 93.5% of the fauna
[illegible] Spiophanes was sparse at all four stations
[illegible] were collected at all in two three minute
[illegible]

[illegible] change in predominant substrate type from sand to
[illegible] pronounced change occurred in the benthic com-
[illegible] Haustoriid amphipods, which dominated samples from
[illegible] LRI-4, were completely lacking at stations from LRI-5
[illegible]. They were replaced at these stations largely
[illegible], primarily the species Spiophanes bombyx, Heteromastus
[illegible], and Nereis succinea. Species numbers and diversity were
[illegible] higher at the upper five stations on the inner channel.
[illegible] of epifaunal species also rose abruptly at station LRI-5,
[illegible] most of the species represented were decidedly euryhaline and
[illegible] in the middle and upper reaches of more homoiohaline
[illegible]. Many of the species encountered are typical fouling or-
[illegible] oyster shells in estuarine areas. Barnacles (Balanus
[illegible]), mussels (Brachidontes exustus), hydroids (Obelia dichotoma,
[illegible] (M. pranipora tenuis) were particularly abundant at these
[illegible]. Oyster shells were common at most locations from LRI-5 to
[illegible] of the inlet is strongly influenced by the local
[illegible] species is decidedly reduced under the
[illegible] at the inlet, and the stress of highly variable
[illegible] evident on the epifauna. There were
[illegible] River Inlet comparable to the "live bottom"
[illegible] previously in Murrells Inlet (Calder, Bearden and
[illegible] rich communities of sponges, whip corals, and
[illegible], substrate, and food for a large number of
[illegible], living in the inner channel were most
[illegible] of [illegible] Lyonsia hyalina floridana (Conrad), Tellina
[illegible], and Parvilucina crenulata (Conrad), brittle

and Eudendrium carneum and Sertularia stookeyi (hydroids). Short-term variations in salinity are known to have a greater impact on the epifauna than on the infauna (Sanders, Mangelsdorf, and Hampson, 1965). They demonstrated that salinity in a poikilohaline estuary is much more stable in the sediments than in the overlying water column, and that the epifauna is therefore subjected to greater physiological stress than the infauna.

49 Adjacent waterways. In addition to the nine stations in the inner channel, eight others were occupied in adjacent waterways of Little River Inlet. Polychaetes were the dominant infaunal animals at all of these stations (Table 9). A large number of live oysters, along with typical brackish water oyster associates, were collected at station LRA-1 in the intracoastal waterway. The epifauna was substantially better represented at stations LRA-7 and LRA-8 in Bonaparte Creek than anywhere else in the inlet (Table 10). A number of Euryhaline Marine I species (those tolerating salinities from above 30 o/oo to a minimum of 18 o/oo) were present, suggesting that this creek has polyhaline salinities and probably less-pronounced oscillations in salinity compared with other areas studied in the inlet. Live oysters were common at these two stations, but shells in the creek were heavily infested with boring sponges, and several predatory gastropods were collected. The lowest species in samples from stations in ad acent waterways were obtained at stations LRA-3, LRA-5, and LRA-6; bottom type at each of these stations was predominantly sandy with little shell or other firm substrate.

50 Oyster reefs. Intertidal oyster reefs within 0.5 miles of the centerline of the proposed channel were surveyed and charted during the S. C. Wildlife and Marine Resources Department study (see Plate 9). This included shoreline reefs along tidal creeks and isolated reefs located in shoal and flat areas. The total acreage of intertidal reefs within the area surveyed was limited, amounting to about 2.48 acres. Approximately 1.84 acres of the total were shoreline reefs, including 0.904 acres having heavy coverage, 0.742 acres of medium coverage, and 0.193 acres of light coverage by living oysters. Individual reefs (beds) totaled only 0.638 acres, including 0.586 acres of heavy coverage, 0.025 acres of medium coverage, and 0.267 acres of light coverage. No significant reefs of subtidal oysters were found in the Little River Inlet study area.

51 Clam resources. Approxmately 37 acres of bottoms containing hard clams were located during the Marine Resources study (see Plate 10). These were found in both intertidal and subtidal areas within Little River and its tributary creeks. Bottoms containing hard clams totaled 12 acres in Dunn Sound Creek, 7.4 acres in Horse Ford Creek, 9 acres in Sheephead Creek, and 8.21 acres in Little River.

52 Other animals in the open water community. The open water community is also utilized by waterfowl and shorebirds,particularly during the winter months. Many waterfowl are surface feeders and

dabblers, and are commonly found along the shallow water zones where they feed on submerged or emergent vegetation. Other vertebrates (i.e. mammals, reptiles, and amphibians) are poorly represented in the open water community. Many of these are semi-aquatic and, thus, are temporary residents of the community. The following is a list of typical floral and faunal inhabitants, with the exception of benthic macroinvertebrates which are listed in Tables 5 through 10, of communities associated with open water habitats:

Plankton

Diatoms
Dinoflagellates
Chlorophytes
Jelly fish
Arrow worms
Comb-jellies
Cryptophytes
Xanthophytes
Copepods

Animals with Planktonic Larval Stages

Fish
Crabs
Barnacles
Mollusks
Polychaete worms
Echinoderms
Jelly fish
Comb jellies
Copepods

Nekton

Amphipods
Isopods
Portunid crabs
Squid
Alewife
Atlantic menhaden
Gizzard shad
Bay anchovy
Mummichog
Striped killifish
Rainwater killifish
Sheepshead
Little tunny
Spadefish
Toadfish
Whiffs
Pigfish
Tonguefish
Shrimps
Silver perch
Star drum
Spot
Atlantic croaker
Bluefish
Spotted seatrout
Weakfish
Red drum
Striped mullet
Summer flounder
Tidewater silverside
Atlantic silverside
Pinfish
Atlantic needlefish
Naked goby
Crevalle jack
Spanish mackerel
Black drum
Striped bass

Birds

Common loon
Brown pelican
Double-crested cormorant
Ring-billed gull
Herring gull
Black skimmer

Birds (continued)

Osprey	Royal tern
Merganser	Least tern
Laughing gull	Belted kingfisher
Mallard	Ruddy duck

Mammals

Bottle-nosed dolphin

Reptiles and Amphibians

Atlantic loggerhead turtle
Diamondback terrapin

Tidal marsh. The tidal marshes of the Little River Inlet marine system are classified as salt marshes since their plant composition generally reflects the strong marine influence on this region. For this study, the S. C. Wildlife and Marine Resources Department under contract to the U. S. Army, Corps of Engineers inventoried the marshland vegetation of the Little River Inlet area (see Plate 11). A discussion of the pertinent aspects of this study is presented in the following paragraphs.

For the purposes of this study, the salt marshes of Little River Inlet were separated into two major zones based on tidal elevation and vegetative composition: (1) low marsh and (2) high marsh. The regularly flooded low marsh extends from a point slightly above the mean low water mark to the approximate mean high water level, while the high marsh occurs above this zone in an area which is flooded only at irregular intervals by higher than average tides, i.e., spring and storm tides. This difference in tidal elevation and related physical conditions (i.e., submergence and exposure, soil salinity, etc.) is evidenced by an obvious change in plant community composition between these two marsh zones. A list of plant species observed during the Marine Resources Division's study is presented in Table 11. Table 12 outlines the plant composition, dominant vegetation, and approximate elevation at the tidal marsh stations surveyed during the study. Station locations are shown on Plate 11.

The Little River Inlet system contains about 1,050 acres of tidal marshland. Of this amount, about 900 acres or 85 percent of the total is low marsh acreage dominated by a single plant species, smooth cordgrass. Lacking formidable competitors, this plant dominates the intertidal marsh where it attains heights of six feet or more along the creek margins.

High marsh covers about 150 acres or 15 percent of the total marshland acreage. In contrast to the monotypic low marsh, plant cover of the high marsh is more varied, with several halophytes

...arsh in abundance: glasswort, sea lavendar, ...ter, salt grass, and salt marsh bulrush, as well as a ... of smooth cordgrass. As the high marsh approaches the ... other marsh plants enter the community: salt marsh ... side goldenrod, black needlerush, high tide bush, sea ..., wax myrtle, and broomsedge. This upper high marsh ...ated by marsh-hay cordgrass and saltgrass, while sea ... bush and salt marsh bulrush are also quite abundant. ... threesquare are locally abundant in the marshes near the ...ly associated with freshwater inflow of Little River.

...communities have been well documented in terms of ...inal diversity, and importance to the marine system (and ...basis of the importance of these marsh communities in- ...mary productivity of the marsh itself and its function ...nutrients. The detritus deposited each year when the ... decomposes provides a food base upon which the es- ... thrive. The dense plant growth in the marsh provides ... for many species of birds, aquatic and semi-aquatic mam- ...and amphibians. Substrates in these communities are ...rich in a variety of foraminiferans, nematodes, annelids, arthro- ... such as the salt marsh snail, marsh periwinkle, ribbed muscle, ...oyster, and crustaceans such as the penaeid shrimps, sand fiddler, ...and blue crabs. The marsh community provides a nursery ground ...for several commercial marine organisms of the state; white and brown ...blue crabs. Marsh creeks also serve as spawing and nursery grounds ...for commercial and sport fishes and shellfishes, in addition to ...shellfish growing areas.

Throughout these marsh communities numerous shorebirds, ...gulls, herons, and egrets will be found. Birds such as ...plovers and sandpipers thrive on the benthic invertebrate ...population around the shoreline and on open flats. In the open water ...communities, waterfowl will be found feeding on vege- ...tation and marine fishes and free swimming invertebrates. Another ...bird found is the clapper rail, a permanent resident of these ...marshes. Herons and egrets feed on fish, invertebrates, reptiles, ...amphibians, and small mammals in the marsh. They also are found nesting ...in the marsh during the summer months. Many gulls will be found the ...year utilizing these communities for resting and scavenging. ...Passerines such as the red-winged blackbird, common and boat-tailed ...grackles, sparrows, and warblers will be found nesting and feeding on ...the seeds and grains. Birds of prey such as the osprey and marsh hawk ...will be found utilizing these communities to some degree.

Mammals of the marshes typically include the raccoon, ...rice rat, opossum and marsh rabbit. The raccoon and opossum are ...omnivorous animals and opportunistic feeders. The otter thrives on ...crabs and fish while the rice rat and marsh rabbit are herbivores. ...Occasionally other mammals such as the bobcat and fox will visit these

flats occupy
by the Little River Inlet
lie below the mean high
exposed by wind-driven or
vascular plants but are fre
, bacteria, oysters, and
ally fringed with stands of
with cordgrass and open water
the inlet, the flats are
above the mean high water mark and are
In these instances, the flats are
of saltwort, smooth cordgrass,

an influx of particulate
nutrient supply for
when the tidal flats are covered
constitute an important food
When the flats are exposed, the
various wading birds and shorebirds. A
is as follows:

Long-billed dowitcher
Dunlin
Semipalmated sandpiper
Herring gull
Ring-billed gull
Laughing gull
Least tern
Royal tern
Gull-billed tern
Short-billed dowitcher
Caspian tern
Black skimmer
Lesser yellowlegs

Amphibians

Bullfrog

Gray treefrog
Southern toad

Sunray venus
Cross-barred venus
Quahog
Eastern oyster

2.62 Disposal areas. Disposal areas used for deposition of [illegible] during maintenance of the AIWW and emergency dredging [illegible] Little River Inlet channel comprise about 57 acres. The [illegible] facilities that were present on these sites prior to disposal have been obliterated. Upon revegetation, these areas usually contain [illegible] communities that are similar in appearance and composition to those which naturally occur in the surrounding environment. Old dredged material disposal areas in the Little River Inlet system are [illegible] vegetated with smooth cordgrass, glasswort, sea lavender, sea [illegible], sea oxeye, marsh elder, wax myrtle, coastal cedar, and sea myrtle. Wildlife species commonly observed in these areas include black skimmers, American oystercatchers, terns, gulls, herons, egrets, several species of [illegible], raccoon, and rodents.

2.63 Sport and commercial fisheries. The Little River Inlet system is a significant contributor to the economy of the adjacent counties in North and South Carolina in terms of recreational and commercial fisheries. There are eight marinas and numerous private docks located in the vicinity of Little River Inlet. Personal pleasure craft numbered at the inlet include about 310 outboards, 230 inboards, 100 cruisers, and 30 sailboats. In addition, there are many transient boats hauled into the area for day use. These boats are used for fishing, crabbing, shrimping, oystering, water skiing, and pleasure riding. There were 16 party and charter fishing boats utilizing the inlet in March 1976. Fourteen of these boats work out of the village of Little River and two work out of Calabash, North Carolina. Common salt water game fish caught in inshore waters by the small boat and surf fishermen include such species as spot, seatrout, black and red drum, flounder, kingfish, pompano, black sea bass, croaker and Spanish mackerel.

2.64 Commercial fishing vessels operating out of Little River Inlet as of March 1976 include three boats based at Seaside Landing, four at Bonaparte Landing, thirteen at Calabash, North Carolina, and five at the Hurricane Marina in Little River, South Carolina. Available data on annual commercial fishery landings are presented in Table 13. Data presented in this table were compiled from the records of liscensed fish dealers by the Department of Commerce in cooperation with the S. C. Wildlife and Marine Resources Department and N. C. Department of Natural and Economic Resources. As shown in Table 13, the major commercial species landed in the area are mullet, spot, sea bass, thread herring, menhaden, shrimp, and oysters.

2.65 Recreation. Little River Inlet is located on the northern end of what is known as the Grand Strand, South Carolina's most popular vacation area. The "Strand", famous for its gently sloping-fine white sand beaches, is a 50-mile seashore vacation land and recreational area. In addition to its famous beaches, the Strand offers abundant motel, motel, and camping areas, 13 ocean fishing piers, numerous championship golf courses, miniature golf courses, amusement parks, and two state parks, Huntington Beach State Park and Myrtle Beach State Park.

2.72 Several mounds were also found on the island with one site being selected for excavation by Dr. Engelmayer. The site appeared to be a large shell ridden about 45 meters long, 15 meters wide, and 3 meters high. The mound was covered with a layer of shell up to 40 centimeters in depth. Small fireplaces consisting of fine ashes and charcoal were found in a portion of the mound. A few long bones and jaws of white-tail deer, raccoon, turtle, and alligator were found around the edges of the fireplaces. Artifacts consisting of potsherds, lithic material, bone tools, and worked shells were concentrated in the lower five centimeters of the shell layer. The archeological material excavated at the site places it in the cultural period of late Wilmington complex and Savannah I phase and an approximate date of 500-1000 A.D.

2.73 Economic indicators. The standard indicators and others found to be related to the Little River Inlet area are keyed to the State of North Carolina, State of South Carolina, and U. S. Department of Commerce, Bureau of Economic Analysis (BEA) Economic Area Numbers 24 and 30. These economic areas have been delineated by the BEA and the Economic Research Service (ERS), Department of Agriculture, who have made national and area economic projections to 2020 for the Water Resources Council. The Series E projections dated April, 1974 have been adopted as the current appraisal of the long-range national trends for planning purposes. These projections are designated as "OBERS Projections." BEA Area 024 consists of eleven North Carolina counties: Brunswick, Columbus, New Hanover, Pender, Duplin, Onslow, Jones, Lenoir, Craven, Carteret, and Pamlico. BEA Area 030 consists of nine South Carolina counties: Georgetown, Horry, Marion, Williamsburg, Dillon, Florence, Darlington, Chesterfield, and Marlboro. Projections for progressively smaller areas were made with regard to their expected performance relative to the larger areas of which they are a part. Projections have been made to the year 2020.

2.74 Population. According to the 1970 U. S. Census of Population, the 1970 population of the State of South Carolina was 2,590,516, an increase of 8.7 percent over its 1960 population and a decrease from the 12.5 percent increase registered during the 1950-1960 decade. The 1970 population of North Carolina was 5,082,059, an increase of 11.5 percent over its 1960 population and a decrease from the 12.2 percent increase registered during the period 1950-1960. Horry County had a 1970 population of 69,992, an increase of 2.6 percent over a 1960 population of 68,247. Brunswick County had a 1970 population of 24,223, an increase of 19.5 percent over the 1960 population of 20,278

2.75 Employment. The average annual employment in South Carolina totaled 1,053,000 in 1973 with about 4.1 percent of the labor force unemployed. (S. C. Employment Security Commission, 1975). About 375,200 persons or 36 percent were employed in manufacturing; 171,700 or 16 in Government; 171,500 or 16 in wholesale and retail trade; 110,200 or 11 in services; and 7 in contract construction. The remainder were either self-employed or in agriculture, forestry, and fisheries; mining; transportation, communication, and public utilities; and finance, insurance, and real estate. Average annual employment in Horry County in

amusement and recreation services is found throughout the smaller economic areas. After 1980 annual growth rates are expected to decline with all economic areas showing less than one percent growth for each 10-year period.

2.81 While employment growth in amusement and recreation services is expected to be minor in the years to come, the growth of earnings from these services is expected to have a brighter future. These earnings in the United States are projected at an annual growth rate of about three precent while employment for the same area was projected at less than one percent. The difference in the rates in BEA Areas 024 and 030 is three percent for earnings and 0.2 percent for employment.

2.82 Transportation. The area has a fair transportation system. Good highways make it accessible from all directions. U. S. Highway 17, which parallels the ocean front along the entire area, connects all northern and southern points. U. S. Highways 378, 501 and 521 and S. C. Highway 9 provide connections to west, mid-west, southwest and northern localities. A multi-lane expressway from Florence to Myrtle Beach was recently opened. It is served, for freight service only, by the Seaboard Coast Line Railroad. The AIWW, with a 12-foot depth, traverses the Atlantic coast and is traveled by many pleasure boats as well as by freight barges. The AIWW and Little River provide the only public access to the inlet. There is a Myrtle Beach - North Myrtle Beach municipal airport, with a 6,000-foot runway but no tower facilities, served by Piedmont Airlines. Smaller fields are those serving Loris and Tabor City (jointly), and the Horry County airport at Conway. Bus service is provided by Trailways and Greyhound.

2.83 Future environmental setting without the project. Population centers are expected to expand to accommodate a growing population and new industries. This expansion will be achieved at the expense of undeveloped lands. Acreage currently devoted to cropland and forestry will continue to decrease as lands of this type yield to the pressures of urban development. The population in BEA Economic Areas 024 and 030 in 1970 was 884,488 or about 11% of the total population of the States of North and South Carolina. This represents a 4% increase in population over 1960 for the two BEA Economic Areas and a 13% increase for the two states as compared to a 13% increase for the United States as a whole. Projections indicate that state populations will increase at an average annual rate of about 1% as compared to about 0.5% for the two BEA Economic Areas through the year 2020. The labor force for BEA Areas 024 and 030 was about 38% of its population in 1970, compared to 40% for the two states. These ratios are expected to continue through 2020. The annual growth rate for personal per capita income from BEA

[illegible] will increase from 71 [illegible] of the United States average per capita income by 2025. Development in the area is expected to continue to concentrate and intensify along the Atlantic coastline in Horry and Brunswick Counties with or without the proposed project.

[illegible] Relationship to Land Use Plans

The proposed project is not considered to be potentially conflicting with any existing or proposed land use plans in the Little River Inlet area. The proposed jetty and possible future fishing walkway would be compatible with the state park proposed for development on Waties Island. The project has been and will continue to be coordinated with state and local planning agencies.

[illegible] Probable Impact of the Proposed Action on the Environment

The proposed plan of improvement includes the construction of jetties and sand dikes and the dredging of entrance and inner channels and two [illegible]. The project will require the removal of about 1,280,000 cubic yards of material by hydraulic pipeline dredge. This material is mostly sand and will be used for construction of sand dikes and beach nourishment. The major adverse effects of this project relate to effects on water quality and on the ecosystems in the disposal areas, channel areas, and other areas within the inlet which will be disturbed by construction activities. Beneficial effects relate to the provision of a navigation channel for the safe operation of charter, recreational, and commercial fishing boats.

[illegible] Water quality. The proposed project is not expected to create any long-term or large scale adverse impacts or detrimental [illegible] the water quality of the Little River Inlet system. As is characteristic of any hydraulic dredging operation, water turbidity in the vicinity of the dredge will increase as a result of the mechanical action of the dredge cutterhead. Turbidities will also increase adjacent to beach disposal areas. However, since all materials to be dredged during project construction are of a sandy nature with a rapid settling rate, any increases in turbidity are expected to be insignificant and of short-term duration and will not affect the long-term productivity of the Little River Inlet estuarine system. As discussed in [illegible] sediments did not contain [illegible] amounts that would adversely affect water quality during the dredging and disposal operation (see [illegible]). Water quality impacts resulting from periodic maintenance [illegible] will be similar to [illegible]. If the fishing walkway is constructed, [illegible] will be [illegible] and [illegible] jetty [illegible] inland to [illegible].

the jetties would provide substrate for epifaunal assemblages and benthic algae, both of which are very limited in the entrance channel area at the present time.

4.08 The lower half of the inner channel is currently dominated by sand-dwelling haustoriid amphipods. If the area remains sandy after completion of the navigation project, these animals should rapidly recolonize the area and community structure should remain essentially the same. If conditions are altered so that the substrate becomes shelly or muddy, it is likely that benthic assemblages would become dominated by polychaetes. The upper half of the inner channel and all of the stations sampled in adjacent waterways were dominated by polychaetes. With the exception of LRA-3, LRA-5, and LRA-7 (see Plate 7), the bottom at these stations was shelly. No dredging appears necessary at any of these locations and little if any impact on the benthos is anticipated.

4.09 As a result of the findings of the above study, it is expected that the disruption or destruction of benthic invertebrates would be a short-term impact as recolonization by organisms disturbed by the cutterhead and recruitment from adjacent areas would begin almost immediately after dredging is completed. The suitability of newly dredged areas for recolonization would or course, be dependent on the interaction of factors such as bottom topography, bottom substrates and habitats, water velocity and current patterns, and future sediment distribution patterns. However, since the composition of bottom sediments is not expected to change appreciably as a result of the proposed dredging it is expected that the populations which eventually become established would be similar to those presently found in deeper channel areas. Due to the continual movement of sand into the deposition basins, numbers and species of benthic organisms inhabiting these areas after construction is completed would probably be low.

4.10 Fish. Available data indicate that fish populations, unlike benthic invertebrates which are relatively immobile and may undergo population reductions that may be locally severe, are less likely to be adversely affected by dredging operations. For example, Stickney (1973) in his study of the Atlantic Intracoastal Waterway in Georgia found no indication of fishes being killed during dredging operations. In some areas, dredging could be considered to be beneficial to certain species of fish, especially those which prey on the larger benthic organisms. As a dredge works its way along a channel, benthic animals which would normally be buried in the sediments are dislodged and become susceptible to predation. This sudden availability of food quite often results in higher than normal concentrations of fishes near the dredge. A similar situation would occur in beach disposal areas. As organisms are dislodged from sandy sediments being deposited on the beach, they become subject to predation by fishes inhabiting the surf zone.

4.11 Although it would appear that fish are relatively unaffected by dredging, there has been some concern recently over the possible effects of increased turbidities and siltation generally associated with dredging. As a dredge moves along the channel, it invariably creates some type of turbidity plume, the size of which will vary considerably depending on the type of sediment being dredged, strength of currents and other factors. The magnitude of the impact of these suspended particles on fishes will, in most cases, be dependent on the concentration, composition, absorbed minerals or toxins and the tolerance of particular species. In general, bottom-dwelling species are the most tolerant of suspended solids, filter feeders are most sensitive and juvenile forms are more sensitive than adults. Under normal circumstances, fish can generally avoid turbid waters and have the ability to clear gill membranes of accumulated silt upon entering undisturbed water (Sherk and Cronin, 1970). However, not all species are equally susceptible to suspended solids and different suspended solids vary in their effect. As a general rule, it has been found that fish can tolerate high turbidities except when they are accompanied by low levels of dissolved oxygen, acids, alkalies, or other substances which interfere with respiration, injure gills or prevent their normal function, and they are quite capable of leaving the immediate dredging area.

4.12 Due to the sandy nature of the substrate in areas to be dredged, turbidity plumes created by the dredge cutterhead would primarily be restricted to the immediate dredging area. Fish species which would have the highest probability of being affected are the filter feeders (primarily menhaden, herring, and shad) and juvenile forms. Estimates of the relative abundance of these species in the area at any given time varies so that it is not practical to attempt a quantitative determination of the impact on these species. In addition, some larval fishes may be destroyed as a result of the mechanical action of the dredge cutterhead. However, based on research which has been accomplished in other areas and available information on the effects of current dredging practices in the area, it is felt that any impact resulting from the proposed dredging would be of a short-term, localized nature and would not significantly affect the fish stocks in the Little River Inlet system. Similar temporary adverse and beneficial impacts would occur during periodic maintenance dredging but would be of a lessened nature due to the lesser amounts of material involved.

4.13 The construction of the jetties would provide substrate for new epifaunal communities of invertebrates and provide habitat for numerous fish species. The combination of a deepened channel flanked by two jetties will concentrate fish food organisms and thereby attract large numbers of marine sport fishes. A jetty related sport fishery would develop shortly after the project is completed and the fishing walkway on the south jetty, if constructed, would provide access to this newly developed fishery by land-based fishermen. Fish species which would be available to anglers on the jetty during various times of the year are sheepshead, black drum, red drum, flounder, bluefish, seatrout, croaker, spot, and whiting.

4.14 Commercial fisheries. The project offers little potential for adversely affecting the areas valuable commercial fisheries industry. As is discussed in Section 4.26 and shown in Appendix A, the commercial fishing industry would benefit from the project.

4.15 Beach community. As discussed in Section 1.0, all material removed during initial dredging operations would be used for beach nourishment and construction of sand dikes. Organisms inhabiting this beach fill zone would be covered as material is pumped onto the beach. When considered in terms of numbers of organisms which may be potentially destroyed, the short-term adverse impact would be significant. However, because animals from high energy beaches are motile and adapted to shifting sediments, rapid recovery of the fauna on these beach areas following the deposition of dredged materials is likely. This is particularly true if the dredged material is similar to that of the original beach in grain size and other characteristics (Thompson, 1973). The intertidal areas of Waties Island and Bird Island were populated by only a few species, all of which are typical of sandy beaches. Haustoriid amphipods and the bivalve Donax variabilis were abundant at both locations. These organisms continually undergo rapid population turnovers and have high resiliency following disturbance.

4.16 Oysters. Intertidal oyster reefs in the study area were small and widely scattered, totaling about 2.5 acres. No dredging or disposal operations are planned within the immediate vicinity of these reefs. Therefore, no extensive sand transport from the inlet channel dredging is expected and no physical damage to intertidal oyster communities is foreseen.

4.17 Clams. An estimated 37 acres of intertidal and subtidal bottoms containing hard clams were located during the State study. According to the Marine Resources Department, hard clams represent the most potentially valuable molluscan resource in the Little River estuary. In spite of the present closure of the area to shellfishing, hard clams could be removed by commercial operators and replanted in clean waters elsewhere for depuration prior to marketing. Hard clam bottoms were primarily located near the inner shorelines of Little River and in tributary creeks, and none were found within the proposed Inlet channel area. Immediate physical effects of the proposed dredging on these resources should be minimal.

4.18 Marsh. Construction of the south sand dike may require the filling of approximately three acres of upper high marsh and less than one acre of high marsh at the north end of Waties Island. The proposed project would not affect any of the area's valuable low marsh acreage. Loss of the high marsh acreage would slightly reduce the areas productivity. Vertebrate animals displaced or disturbed by construction would move into adjacent areas which have similar habitat and could temporarily stress resident populations in those areas as they compete for available food and cover. Macroinvertebrates would be buried during sand-dike construction. Native plant species would be planted on the sand dikes after construction is completed. As these plants become established, the sand dikes would be utilized by species generally associated with a dune type habitat.

food and cover. Native plant species would be planted on the sand dikes after construction is completed. As these plants become established, the sand dikes would be utilized by species generally associated with a dune type habitat.

4.19 Pine forest. A small amount of pine forest (approximately four acres) would be cleared during construction of the sand dike at the north end of Waties Island. Impacts associated with this clearing include a slight reduction in primary productivity and displacement of existing animal species. Some animal species would likely move into adjacent areas while others may continue to forage in the area during the construction process. As stated previously, sand dikes would be planted with appropriate native vegetation which would provide some habitat for animal species.

4.20 Endangered species. The only endangered species frequently observed in the area, the brown pelican, would not be adversely affected by the proposed project.

4.21 Mosquitoes. Since this project does not require the use of diked areas for disposal of dredged materials and all materials to be removed are of a sandy nature, the project would not cause any increase in mosquito breeding.

4.22 Archeological and historical sites. The National Register of Historic Places has been consulted and there are no existing or potential register properties which would be affected by the construction of the proposed project. As indicated in Section 2.70, it appears unlikely that significant archeological resources exist in any area which would be affected by construction. However, all areas to be affected by construction which have not been disturbed by previous dredging will be surveyed for archeological content. If the survey reveals no significant archeological resources, then it is considered that the project would not have a significant impact on this resource. If any significant archeological resources are found, a plan of salvage will be prepared and coordinated with the National Park Service and the Advisory Council on Historic Preservation. The actual salvage operation would be conducted in accordance with the coordinated plan of salvage before project construction. The only areas in which archeological resources could exist and be affected by project construction include the exposed ocean beaches bounding the inlet, any as yet undredged portions of the inner channel, and the surf zone where dredging of the entrance channel and jetty construction would occur. In view of the physical characteristics of these areas, it would appear that the real value of any archeological resources therein would not be realized until such resources were salvaged. Accordingly, if significant archeological resources are discovered during the survey, it is considered that the project impact on these resources would be favorable.

4.23 Recreation. The effects of the proposed action on the areas recreational resources would vary from temporary minor inconveniences to boaters in the area to enhancement of the areas boating and fishing opportunities. The jetties would provide a protected entrance to Little River Inlet which would benefit all boaters using the inlet for passage to and from the ocean. In addition, the jetties would provi

habitat for the development of a new jetty-related fishery which is currently not available in the Little River Inlet area. If a fishing walkway is provided on the south jetty it would assure that this fishery would be available to non-boaters as well as boaters. It is estimated that about 40,000 fishermen and 45,000 sightseers would use such a walkway annually by 1980, 50,000 fishermen and 60,000 sightseers by 2000, and 60,000 fishermen and 80,000 sightseers by 2030.

4.24 Aesthetics. The presence of the dredge, pipelines, and other assorted construction equipment will represent a temporary intrusion upon the view of boaters in the area. The physical presence of the sand dikes and jetties may be aesthetically displeasing to some individuals since they will be located in areas which are currently undeveloped.

4.25 Noise and air quality. Operating dredges are generally quiet and contribute less to ambient noise levels than normal motor and speedboat traffic. Air pollution derived from the dredge and other construction equipment should be negligible during both construction and maintenance of the project.

4.26 Economic impacts. The proposed project will have a favorable economic impact on the study area since it will provide direct and indirect benefits to the commercial charter boat industry, commercial fishermen, sport fishermen, recreational boaters, and marinas serving the area. Little River Inlet, because of the shifting sands at the entrance to the inlet, is unstable. Present controlling depth of the waterway is about two to three feet above mean low water. This depth is inadequate for operation of the existing and projected fleet of commercial and recreational boats which require about 12 feet in the ocean and 10 feet in the inner channels for safe navigation. Construction of the proposed project will result in tangible navigation benefits of $1,636,800 per year derived from enhanced recreational boating and commercial charter boat operations, increased commercial seafood landings, reductions in vessel damage, and provision of an all-tide harbor of refuge during storms. In addition, the fishing walkway, if constructed, would provide an estimated annual benefit of $112,000 based on an annual visitation of 40,000 fishermen and 45,000 sightseers. Redevelopment benefits would amount to $70,000 and consist of labor income accruing to those who would be unemployed in such areas, except for the construction of the project.

4.27 The proposed project, by offering better access and safer conditions to all vessels, would result in some increase in business for marinas and other satellite services and businesses located in the Murrells Inlet area. The project might also stimulate the establishment of new businesses and satellite services in the area, especially in areas related to commercial charter and seafood industries.

4.28 Maintenance dredging. Maintenance dredging would be accomplished about every two to three years and would be required in the inner channel and deposition basin. Inner channel dredging would amount to about 9,000 cubic yards annually. All of this would will be used for beach nourishment. Approximately 300,000 cubic yards of material would be removed from the deposition basins annually and placed on adjacent beaches. The impacts of maintenance dredging would be similar to those of initial construction but would be of different order of magnitude.

4.29 Sand bypassing. The proposed jetties would extend out into the ocean well beyond the surf zone. Since the ocean surf is responsible for the movement of sand in the littoral zone along the ocean beaches, the jetties would constitute a barrier to both the upcoast and downcoast movement of sand. This movement of sand or littoral drift process affects the rate at which beaches accrete and erode. The proposed project, therefore, provides for the construction of features designed to maintain the present littoral drift regimen along the shores adjacent to Little River Inlet. Low weir sections would be constructed in each jetty to permit the normal movement of sand across the jetty. Deposition basins would be constructed inside each jetty to provide for the accumulation of all sand moving over the low weir sections. The sand that accumulates within each deposition basin would be periodically pumped out by a hydraulic dredge and deposited outside the jetties on either the upcoast or downcoast beaches as needed. These features are intended to insure that the project would have no effect on the rate at which beaches in the vicinity of Little River Inlet erode or accrete.

5.0 Any Probable Adverse Effects Which Cannot Be Avoided

5.01 The principal adverse effects of constructing the proposed project are related to the dredging of channels and disposal of dredged materials. The dredging would temporarily increase turbidities in the immediate vicinity of the dredge and beach disposal areas during initial construction and periodic maintenance. This increase in turbidity could cause a decrease in primary productivity due to turbid waters reducing the euphotic zone. In addition, some benthic organisms may be destroyed by the dredge cutterhead. Disposal of all suitable material on adjacent beaches during initial and maintenance dredging operations would smother some beach inhabitants. Some macroinvertebrates would also be covered by placement of stone during jetty construction. Species inhabiting the high marsh and pine forest in areas which would be cleared for sand dike construction would be displaced by construction activities. The presence of the dredge, pipeline, and other construction equipment and the jetties and sand dikes may be aesthetically displeasing to some individuals.

6.0 Alternatives to the Proposed Action

6.01 General. Several possible solutions to the problem of providing a stabilized channel of sufficient depth and width for regular use by commercial and recreational fishing vessels were considered. Experience has shown that it is not economically or physically feasible to maintain the channel by dredging alone. Therefore, it was decided that a proper solution must also include structural controls with provisions for sand bypassing. Structural controls considered included jetties, offshore breakwaters, and conventional and special facilities for sand bypassing. An optimum project was selected by maximizing benefits through comparison of cost and benefits for incremental project requirements related to variations in project depths. Five different plans were tested with physical models to determine the best location and arrangement of structural control appurtenances.

6.02 Non-structural alternatives. Construction and maintenance of the required channels were considered using a program of dredging in lieu of structural controls. In February 1975, private

dredging contractors were contacted by Charleston District and asked if they would consider dredging in Little River Inlet and Murrells Inlet with a pipeline dredge. All contractors responded that dredging in these inlets was too hazardous and not feasible for a pipeline dredge. The following reasons were submitted in support of their objections: (1) insurance is void once they go in open ocean waters; (2) a large dredge would require from 6 to 8 feet of water in which to work; (3) a small dredge would not require the water depths that a large dredge would but a small dredge's low pumping capacity would render its operation useless due to rapid shifting of sand in the inlet; and (4) the design of pipeline dredges renders them useless in areas of strong wave action.

6.03 In September 1975, a private consulting engineering firm was employed by Georgetown County to prepare plans and specifications to perform pipeline dredging at Murrells Inlet which is similar to Little River Inlet. A large number of private dredging firms were contacted by the private engineering firm. These dredging companies were requested to signify their interest in undertaking a dredging operation in Murrells Inlet. The responses to this inquiry were also all negative. Two out-of-state dredging firms sent representatives to look at the area before deciding that the work could not be done with their equipment.

6.04 Emergency dredging of the ocean bar was performed in March and April 1976 using the Corps of Engineers' sidecasting dredge, FRY. The channel dredged in May has already begun to shoal.

6.05 The technology does not presently exist in the private or government dredging fleets to adequately maintain Little River Inlet. The Corps of Engineers is not authorized to construct new dredges that would have capability of dredging the inlet, and the private sector appears not to be interested in undertaking the design of a prototype dredge capable of this operation without Federal funds. For the reasons stated in this and preceding paragraphs, dredging without structural controls is considered to be uneconomical and physically impractical.

6.06 The non-structural alternative was also considered more undesirable to the environmental quality of the inlet than plans with structural controls since the more frequent dredging required would be more disruptive to benthic populations. In addition, the non-structural alternative would not provide any sheltered water for small boats navigating the entrance channel because of the absence of a jetty system. Since it is not practical or economically feasible to maintain a dependable channel by any non-structural alternative, further growth in the commercial fishing and charter-boat operations and related businesses would be discouraged. It was therefore concluded that some type of structural control would be required.

6.07 Structural alternatives. Structural alternatives considered included provisions for jetties, trapping and bypassing sands moving along shore; sheltering mooring vessels from wave action; and

maintaining stable channel dimensions and alignments. Schemes considered include:

(1) Two impermeable jetties;
(2) Upcoast jetty with weir and impermeable downcoast jetty; and
(3) Two jetties with weirs in each.

6.08 In the first plan, sands forming the fillet against the impermeable jetty would be exposed to ocean forces and would have to be bypassed using a permanently installed hydraulic plant, a conventional hydraulic dredge requiring offshore breakwater protection, or a submarine-type jet eductor system (not yet perfected). Schemes for trapping littoral drift by the use of weirs would have the advantage of providing wave protection to the conventional pipeline dredge. Littoral drift moving along shore would pass over a low weir section in the jetty and settle into a deposition basin located within the jetty confinement. Sand would be periodically bypassed to adjacent beaches by a conventional hydraulic dredge operating within the protected jetty system to remove entrapped sands from the deposition basin and transport these sands to downdrift or updrift beaches. Considering the previously described actions the best project arrangement was found to be the construction of jetties extending from the barrier beaches on each side of a dredged inlet channel and the sand-bypassing scheme employing overflow weirs and deposition basins for each jetty.

6.09 Alternative depths. Various depths for the entrance and inner channel were considered during project formulation. Entrance channel depths that were considered ranged from eight feet to 14 feet mlw with inner channel depths being two feet less for each level of improvement. The additional two feet in the entrance channel is necessary to allow for the effects of pitch and roll in the ocean. The selection of inner channel depths was based on the loaded draft of the vessel plus an allowance of one-half foot for drag (the designed difference between the draft forward and aft when a vessel is down by the stern), one-half foot for squat (depression of water surface about the hull resulting from the bow and stern wave systems) and two-foot minimum bottom clearance. Using these criteria, boats with drafts up to 3.0 feet could safely negotiate a six-foot inner channel during all tidal stages and boats with up to 7.0 feet of draft could safely use the 10-foot channel which would be provided under the recommended plan of improvement.

6.10 The optimum navigation project was determined through maximization of benefits. Maximum benefits are achieved by incrementally adding higher levels of improvement until the incremental cost of the addition equals the incremental benefits received. Recreational boating and commercial fishing operations, which are now regulated by the tidal cycles, would realize increasing benefits due to greater channel depths until these depths reach a level that would be adequate at all tide stages for the deepest draft vessels expected to use the inlet. Annual benefits from reduction of vessel maintenance would also vary with channel project depth as do the jetty lengths which are based upon entrance channel length which is a function of depth. Cost and benefit analysis data for the various alternatives are presented in Table 14. As shown in this table, Plan C offers the optimum navigation facilities and therefore is the selected plan of improvement.

[illegible] Federal Government Agencies

Environmental Protection Agency

No response received.

U.S. Department of the Interior

1. Additional [illegible] addressing archeological resources and project impacts [illegible] been inserted in Sections 2.10 and 4.22.

2. The suggested [illegible] have been incorporated in this EIS. See also Section 2.05.

3. See response to comment 1. Legislated responsibility for initiating surveys rests with the U. S. Department of the Interior. Prior to 1974, several laws, regulations, and presidential orders stated broad and general goals for protecting cultural resources, but did not provide specific steps for accomplishing all of these goals.

The Advisory Council on Historic Preservation outlined steps by which a Federal agency might comply with the few specific requirements of these laws and regulations, and also accomplish the vaguer, broader goals. Many of these steps were not required by law, but were suggested by the Advisory Council to encourage Federal agencies to adopt uniform procedures for protecting cultural resources.

On 24 May 1974, four months after the 36 CFR 800 regulations were published, Congress passed Public Law 93-291. This law outlined in unusually clear and specific terms the steps to be followed to protect cultural resources. In agreement with earlier public laws and executive orders, but in contrast to the suggestions by the Advisory Council in 36 CFR 800, Public Law 93-291 clearly assigns the responsiblities to the Secretary of the Interior for initiating surveys (Section 4c) and coordinating actions among cognizant agencies and individuals (Section 5). In Sections 4 and 5, the law states the responsibilities which "shall" be performed by the Secretary of the Interior. These include initiation of survey work and coordination efforts. The law does provide in Section 3a and 7a that Federal agencies constructing or licensing a project "may" assist the Secretary by assuming certain tasks related to cultural resources.

In response to the permissive provisions of Sections 3a and 7a, the Corps of Engineers has agreed to assume most of the responsibilities for cultural resources on civil works projects and general investigation studies which were delegated to the USDI by Public Law 93-291 and earlier legislation. This voluntary assumption of responsibilities delegated to the USDI is in agreement with the broad sentiments expressed in the National Environmental Policy Act, Executive Order 11593, and the Historic Preservation Act of 1966, and is also responsive to suggestions of the Advisory Council pertaining to the adoption of [illegible] procedures as outlined in 36 CFR 305. The USDI's reliance on [illegible] procedure by the Advisory Council and declination to acknowledge [illegible] 93-291 is not a tenable position, especially when the latter is [illegible], more specific and more authoritative.

[illegible] that there would be [illegible] disabilities resulting from storm [illegible] of the south.

[illegible] the south sand dike [illegible] of any high marsh acreage still to [illegible] planning.

[illegible] project impacts on archeo- [illegible] Section 4.22 and the detection [illegible] utilized.

[illegible] archeological resources and [illegible] inserted in Sections 2.70 and [illegible] connection with each of the various [illegible] most of the area which would [illegible] alternative has already been dredged [illegible] all alternatives and the recommended project involve [illegible] and would have approximately the same impact on [illegible]. The federal responsibility for archeological [illegible] discussed in response No. 3 to this letter. It [illegible] archeological resources could exist and be affected [illegible] in the exposed ocean beaches bounding the [illegible] portions of the inner channel and the sand [illegible] of the entrance channel and jetty construction [illegible] of the physical characteristics of such areas, [illegible] but the highest value of any archeological resources [illegible] be achieved unless these resources were salvaged. [illegible] of the EIS cites the conflicts [illegible] which would proceed any actual salvage operation.

[illegible] and in other responses to this letter, [illegible] potential for affecting cultural [illegible] discussion of these resources in Section 2.

[illegible] the 1976 citizen [illegible] South American port [illegible] elevations affecting [illegible]

[illegible] tidal elevations was determined
[illegible] predicted the tidal ranges to be reduced
[illegible] when and if scour should occur and
[illegible] to a lesser degree the tidal changes would
[illegible] foot.

[illegible] scour which would occur would make the de-
[illegible] than the average 0.1-foot we have observed

[illegible] inlet projects similar to the Little River In-
[illegible] documented data on before and after construction
[illegible] be used to predict accurately the effects of the
[illegible] However, it has been proven that tidal heights
[illegible] have been accurate in the past and that a physical
[illegible] source of this information now available.

[illegible], USDA, Columbia, South Carolina

[illegible] of the EIS, the sand dikes will be planted with
[illegible] salt tolerant plant species. A vegetative plan will be
[illegible] the latter stages of project design, prior to the initiation
[illegible].

[illegible], USDA, Raleigh, North Carolina

[illegible].

[illegible] and Welfare

[illegible].

[illegible] Urban Development

[illegible]

[illegible], USDT

[illegible] Affairs

[illegible] littoral drift impinging on each
[illegible] equal. If littoral drift is predominantly
[illegible] will migrate.

[illegible], Little River Inlet has been rather stable in location, with the state line offering a rather definite reference point. Its locational stability together with its rather isolated lens of hinterland marsh suggests a closely balanced volume of littoral drift material moving from both directions. Analysis of available records for about the last five years suggests, during that period, a predominance of about [illegible],000 cubic yards a year moving westward. The geological evidence, however, suggests that at some point very near Little River Inlet, with slight secular shifts, the littoral drift from the two directions has been balanced over a long period of time. The persistence of the inlet indicates that it is effectively bypassing the gross littoral drift volume; that is, the sand impinging from both sides. Installation of a jetty would fix the location of the inlet thus preventing minor migrations of the inlet that are a part of the natural bypassing system, as by the gain and loss of material from a middle ground shoal, or by the movement of sand across an offshore bar by way of channels traversing the bar and switching directions through the bar. The effects of this natural bypassing should be preserved by artifical bypassing means, as are contemplated in the improvement, in order to forestall erosion of the adjacent beach areas.

2. The Corps does not initiate federal water resource projects. These projects originate with a request for assistance from local interests to a United States Senator or Representative, who submits the request to either the House or Senate Public Works Committee. If the Committee is convinced of the need for assistance, an authorization for an investigation will be included in an authorization bill for consideration by the Congress. When passed, the bill becomes a directive to the Corps for a study. If Congress also appropriates funds for the study, the Corps then conducts the study and submits a report to the Congress. If the report recommends action by the federal government and if Congress approves the report, it will authorize the construction of a federal project. Construction will begin only if and when Congress appropriates funds for that particular project.

3. A study of the project's effects on the areas biological resources will be included in the monitoring program. A summary of the monitoring program presented in the GDM has been included in the EIS.

4. [illegible] information has been included in Section 1.24 and [illegible] Final EIS.

North Carolina Department of Human Resources

1. No [illegible] is required.

2. [illegible] disposal areas will not be required for project construction. Material cannot therefore, the project has no potential [illegible] relating to the local mosquito population.

North Carolina Department of Natural and Economic Resources

No response is required.

South Carolina Wildlife and Marine Resources Department

1. Additional plant species have been included in the subject paragraph.

2. These species have been included in this final EIS.

3. The subject section has been revised as suggested.

4. The number of tidal marsh stations has been corrected.

5. The EIS has been revised as suggested.

6. Additional species have been included in the subject paragraph in the final EIS. Since no low marsh communitites will be adversely affected by the proposed project it is not considered necessary to include a comprehensive listing of animal species utilizing this marsh.

7. Additional species have been included in this final EIS.

8. The subject paragraph has been revised as suggested.

9. The possibility of relocating the south sand dike so as to avoid potential disturbance of any high marsh acreage will be studied during preconstruction planning.

S. C. Department of Health and Environmental Control

No response is required.

S. C. Department of Archives and Administration

No response is required.

South Carolina Water Resources Commission

1. The EIS covers the impact of all construction associated with the navigation project which does not include the park which may or may not be developed by the S. C. Department of Parks, Recreation, and Tourism. The benefits for the fishing walkway are shown as separate items in Appendix A. The B/C ratio shown in this Appendix is, as stated, for navigation facilities only. The B/C ratio for recreation facilities has been included in Appendix A of this EIS.

2. The recreational development described in Secion 1.11 is an integral part of the Little River Inlet project and is appropriately included in the EIS.

3. All facilities will comply with all Federal laws and regulations.

4. Access to the proposed walkway would be provided by State operated electric powered vehicles as is noted in Section 1.17 of this EIS. The 90° pattern for parking stalls was adopted because it is more efficient in terms of overall capacity.

5. No response is required.

6. The data utilized in this paragraph is the most recent published data.

7. The suggested revisions have been incorporated in this EIS.

8. Since no specific reason is given for the conclusion that the project is undesirable from an environmental viewpoint, additional information and/or response cannot be included in this EIS. However, with reference to the statement that only limited secondary benefits would accrue to the general public, it should be noted that all boat owners and other recreationists that utilize any part of the project belong to the general public.

Cape Fear Council of Governments

No response is required.

Waccamaw Regional Planning and Development Council

1. In cases such as the Little River Inlet EIS, where a large number of plates are utilized, plates are placed at the end of the EIS to facilitate review of material in the text.

2. A legend has been included in Plate 5 in this final EIS.

3. Model studies being conducted by the U. S. Army Corps of Engineers, Waterways Experiment Station indicate that the project would have little if any effect on areawide hydrology and therefore should not affect the distribution of future waste loads.

4. The S. C. Department of Parks, Recreation, and Tourism has been negotiating with the owners of Waties Island in an effort to either purchase or lease the island for the purposes of developing a state park. If such plans should materialize, the Department has indicated that they would be willing to participate in the construction and operation of a fishing walkway on the south jetty.

5. The subject sentence has been clarified in this final EIS.

6. We are cognizant of the current status of the loggerhead sea turtle. Although construction schedules have not been finalized as yet, effort will be made to schedule construction during periods of lowest biological activity.

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Cronin L. E. Summary, conclusions, and recommendations. 15 pp.
Biggs, R. B. Geology and Hydrology. Project A. Reference No. 69-23. 36 pp.
Flemer, D. A. Phytoplankton. Project B. Ref. No. 69-15. 15 pp.
Pfitzenmeyer, H. T. Benthos. Project C. Ref. No. 69-130. 30 pp.
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GLOSSARY

algae - any of a group of chiefly marine or freshwater aquatic plants with no true leaves, stems, or roots ranging in size from microscopic single-cell organisms or colonies to large macroscopic seaweeds.

Amphipoda - large order of malacostracan Crustacea; includes the sideswimmers, sand hoppers, etc.; body compressed; first thoracic segment fused with head; no true carapace; mostly scavengers; most spp. marine, burrowing or moving about on the bottom and debris.

anaerobic - refers to life or processes that occur in the absence of oxygen.

Annelida - phylum consisting of elongated, segmented worms; includes earthworms, leeches, and many kinds of marine forms.

aquifer - an underground bed or stratum of earth, gravel or porous stone that contains water.

Arthropoda - largest phylum; characterized by a segmented body, segmented appendages, chitinous exoskeleton, and an extensive hemocoel; includes crustaceans, insects, spiders and their relatives, centipedes, millipedes, etc.; in all types of habitats.

association - in an ecological sense, a subunit of community organization identified by its major organisms.

benthic region - the bottom of a body of water. This region supports the benthos, a type of life that not only lives upon, but contributes to the character of the bottom.

benthos - the plant and animal life whose habitat is the bottom of a sea, lake or river.

biota - all the species of plants and animals occurring within a certain area.

biotic - of/life.

bivalve - any member of the molluscan Class Pelecypoda. Having a shell of two parts which are joined by hinge, as in pelecypods.

bloom - to flower; of algae, to appear or occur suddenly or in large quantity or degree.

Bryozoa - ectoprocta; phylum which includes the "moss animalcules"; small tufted or branched marine and freshwater organisms a few mm. high; attached to substrates.

canopy - the uppermost layer of leaves, twigs, and branches of forest trees, or of other woody plants.

carnivore - a flesh eater. The highest trophic level(s) at the top of most food chains.

coliform - any of a number of organisms common to the intestinal tract of man and animals whose presence in waste water is an indication of pollution and of potentially dangerous bacterial contamination.

colonize - to establish a colony in or on.

community - collectively, all of the organisms inhabiting a common environment and interacting with each other.

detritus - in the ecological sense, any fine particulate debris of organic or inorganic origin.

diatom - a uni-cellular form of algae with walls impregnated with silica.

dissolved oxygen - the oxygen dissolved in water or sewage. Adequately dissolved oxygen is necessary for the life of fish and other aquatic organisms and for the prevention of offensive odors. Low dissolved oxygen concentrations generally are due to discharge of excessive organic solids having high BOD, the result of inadequate waste treatment.

diurnal - activity by daylight; opposite of nocturnal. Occuring every day.

diversity - refers to the number of different kinds of species in an area.

dominant - a species or group of species which largely control the energy flow and strongly affect the environment within a community or association.

ecotone - transition or interdigitated area between two adjacent communities, the merging zone or adjacent forest and grassland.

environment - sum of all physical, chemical, and biological factors to which an organism is subjected. One of the major habitat types, such as marine, terrestrial, rain forest, desert, lake, etc.

epifauna - bottom fauna living on the surface of the bottom deposits in the water.

erosion - the process of wearing away by the action of water, wind, or glacial ice.

estuary - the area where the fresh water meets salt water. For example, bays, mouths of rivers, salt marshes and lagoons. Estuaries are delicate ecological systems of nurseries, spawing and feeding grounds for larger forms of marine life and provide shelter and food for birds and wildlife.

fauna - [illegible] animal life of any particular area or [illegible]. A list of animal species and descriptions of a particular area or time.

filter feeder - [illegible] animal that obtains its food (usually small particles) by filtering it from water; e.g. Daphnia, clams, [illegible]

flora - the [illegible] peculiar to a country, area, specified environment, or period.

Foraminifera - [illegible] of the orders of the Class Sarcodina; main bulk of the cell is enclosed within a simple or chambered and/or coiled shell or test composed of secreted calcium carbonate [illegible], silicon dioxide, or bits of foreign material [illegible] together with an organic secretion.

formation - [illegible] sedimentary bed or consecutive series of beds sufficiently [illegible] or distinctive to be a unit.

fossiliferous - containing fossils.

habitat - [illegible] place where a particular plant or animal lives usually used in a much more restricted sense than [illegible] refers to a smaller area; e.g. spring [illegible], tide pool, sandy bottom, and sandy beach.

halocline - boundary between water layers of differing salinities.

hydroperiod - rainy season.

in situ - in place.

infauna - fauna consisting of burrowers in the bottom deposits

intertidal zone - that portion of the sea bottom between high and low tide lines; depending on tidal amplitude and slope of the bottom, the intertidal zone may be narrow or very wide.

invertebrate - collectively, all animals without a vertebral column.

Isopoda - [illegible] of crustaceans; includes pill bugs, [illegible] body depressed; first thoracic [illegible] fused to head, some or all segments [illegible] gills; found in a variety of salt and fresh waters.

larva - general term for any independent, active, immature stage [illegible] morphologically quite unlike the adult; [illegible] and metamorphosis in most cases.

littoral - that shallow portion of the bottom extending from the shoreline to a depth of 200 m.; the term is also used to include both the bottom and the water above the bottom at the depths indicated.

microscopic - Indistinguishable without the use of a microscope.

Mollusk - Mollusk; any member of the Phylum Mollusca; Phylum including soft-bodied animals usually partly or wholly enclosed within a calcium carbonate shell and having a muscular "foot" for locomotion.

nekton - collectively, the macroscopic animals suspended in the water of ponds, lakes, rivers, and seas; they move about independently of currents and include such forms as fishes and whales.

Nematoda - Phylum which includes all the true roundworms; body slender, cylindrical, often tapered near ends, and covered with a cuticle; 100 microns to 1 m. long; marine, freshwater, terrestrial, and parasites of plants and animals.

nursery area - an area where animals congregate for giving birth or where the early life history stages develop. e.g. estuaries for shrimp

pelagic - of or pertaining to the open waters of the sea and lakes, especially where the water is more than 20 m. deep.

photic zone - the region of aquatic enviornments in which the irtensity of light is sufficient for photosynthesis.

photosynthesis - synthesis of carbohydrates from carbon dioxide and water with chlorophyll as a mediator using light as energy with oxygen as a by-product.

physiography - a description of nature or natural phenomena in general.

phytoplankton - small, mostly microscopic, plants floating in the water column.

pioneer - any early occupant of an open or disturbed area of ground.

plankton - collectively, all those organisms suspended in the water of an aquatic habitat which are not independent of currents and other water movements; most such organisms are microscopic and commonly include bacteria, algae, protozoans, rotifers, larvae, and small crustaceans.

population - a group of organisms of the same species.

producer - any organisms able to synthesize organic compounds from simple inorganic substances, e.g. green plants.

[illegible] stored [illegible]

[illegible] cytoplasm, nucleus, chromosomes [illegible] protozoans, most algae, [illegible]

[illegible] partly along and partly under [illegible] but shoots above and roots below.

[illegible] permanently attached to a substrate, such as [illegible] or sponge.

succession - series of communities which follow one another in slow but definite sequence, ending in a climax typical of a particular habitats and geographic area; such series may be completed in [illegible] years or up to thousands of years.

sessile - attached to a substrate; not motile. Without a stalk.

substratum - the ground or any other solid object to which an [illegible] is attached, on which it moves about, or with which it is otherwise associated.

succession - the replacement of one community by another, the definition includes the (controversial or hypothetical) possibility of "retrograde" succession.

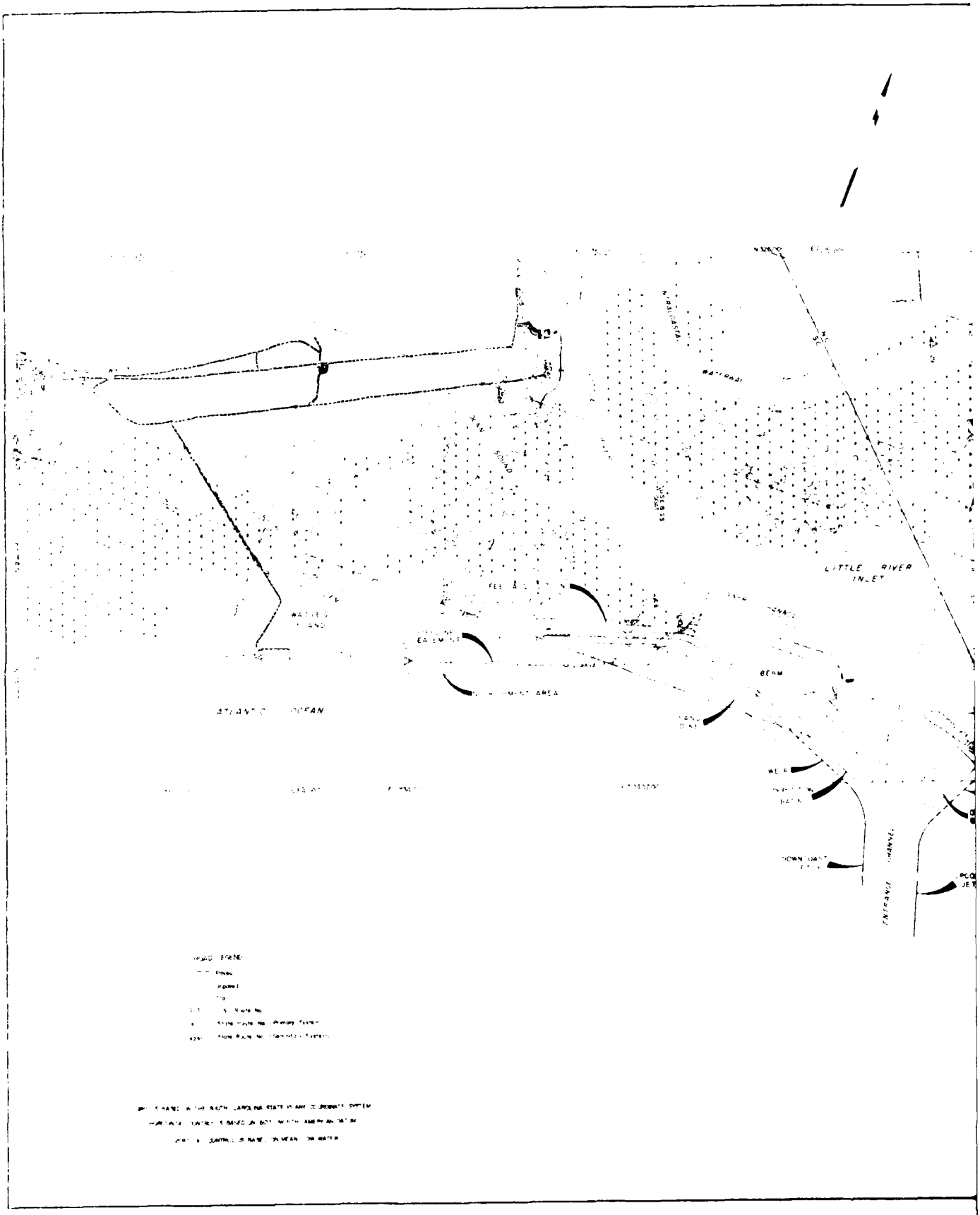
terrace - a raised embankment with the top leveled. A level ordinarily narrow plain usu. with steep front bordering a river, lake, or sea.

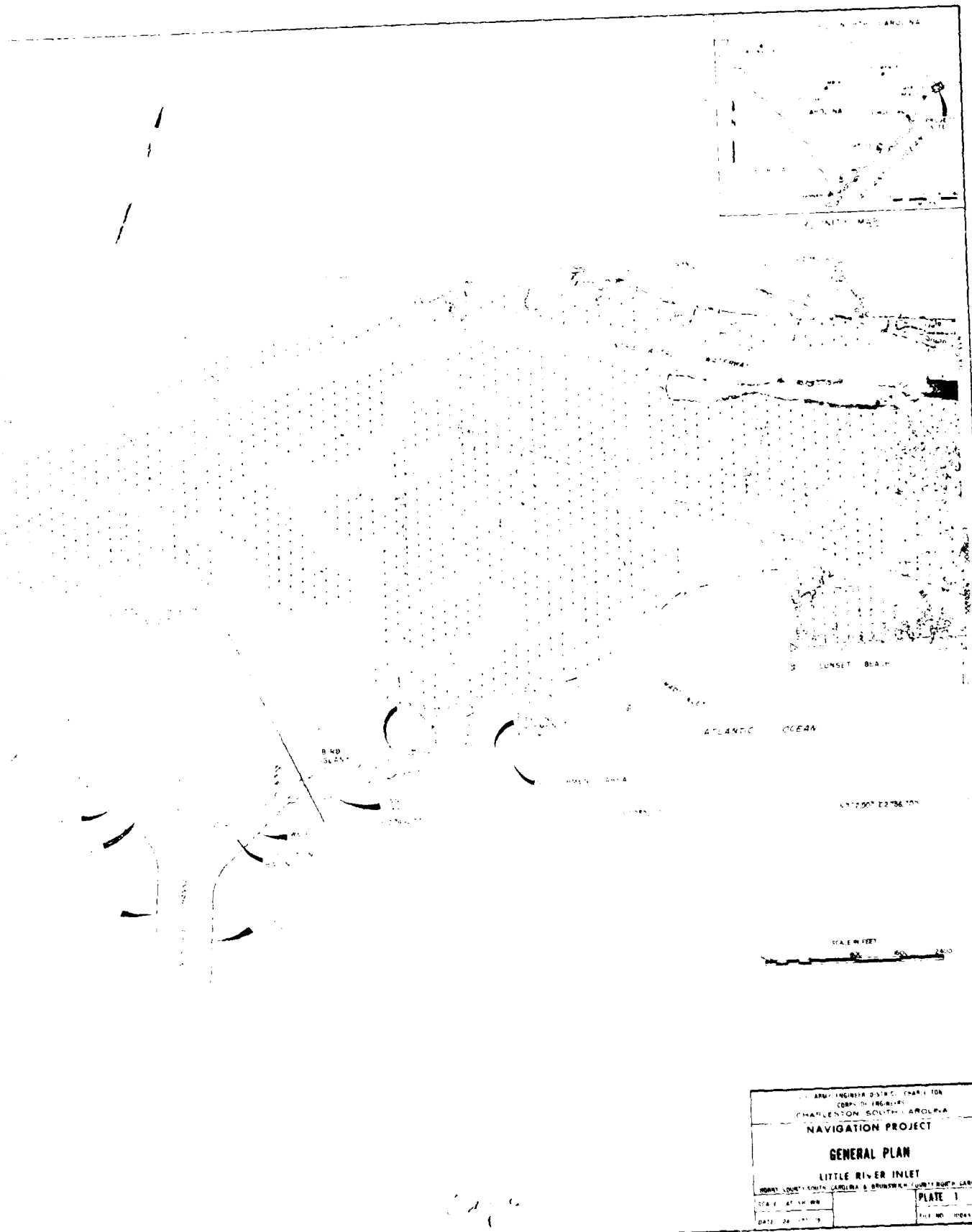
Tunicata - subphylum in the Phylum Chordata; includes the tunicates, ascidians, salps, and sea squirts; highly modified marine [illegible] having a more or less cylindrical or globular shape; [illegible] wall covered with a secreted cuticular tunic; sessile, free-swimming, or suspended at surface; solitary or colonial.

turbidity - condition of water resulting from suspended matter, water is turbid when its load of suspended material is [illegible].

vascular - containing or containing vessels adapted for transmission or circulation of fluid.

xeric - [illegible] or pertaining to conditions of scanty [illegible] supply.


LITTLE RIVER INLET
BERM



ARMY ENGINEER DISTRICT, CHARLESTON
CORPS OF ENGINEERS
CHARLESTON, SOUTH CAROLINA

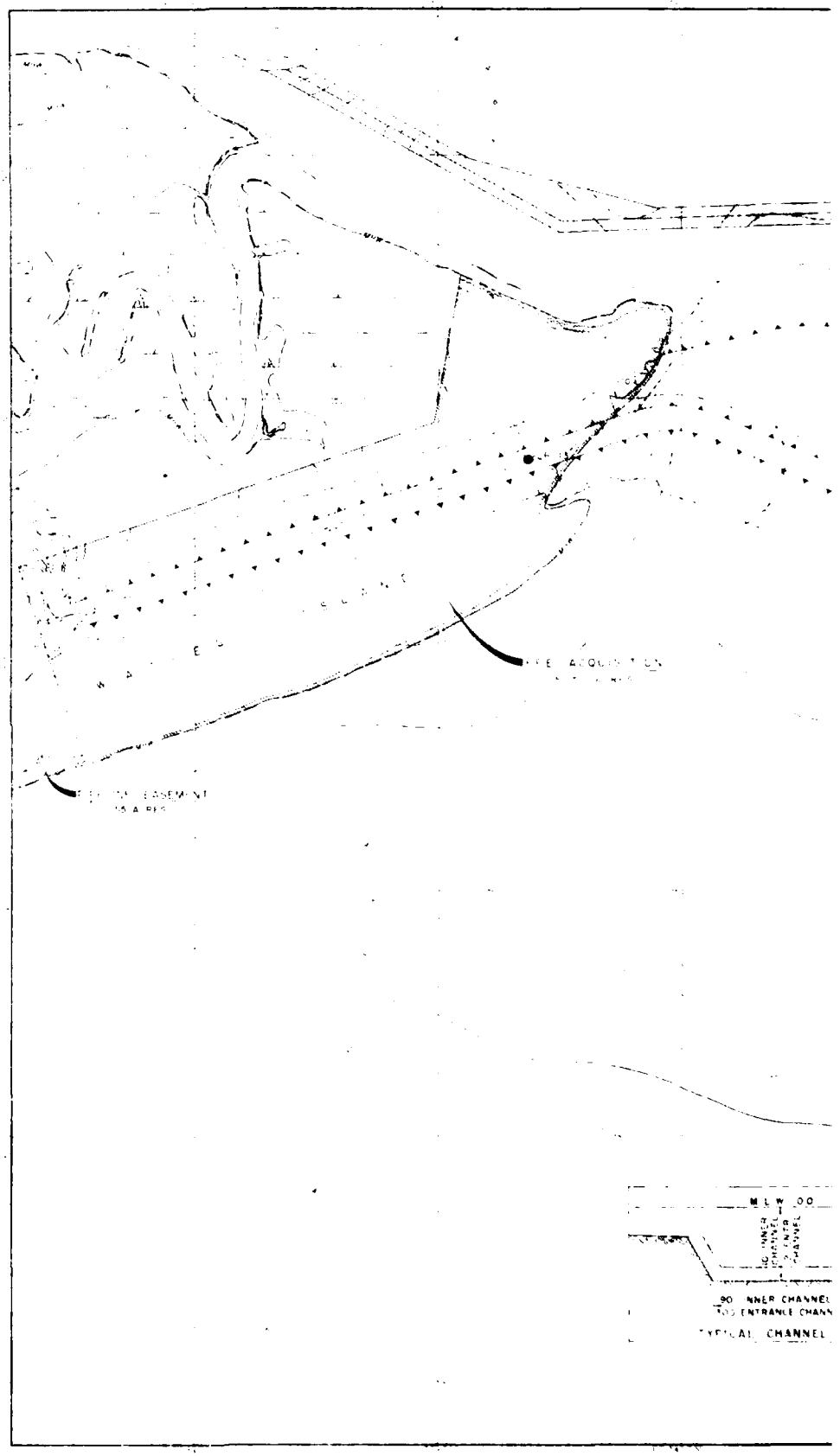
NAVIGATION PROJECT

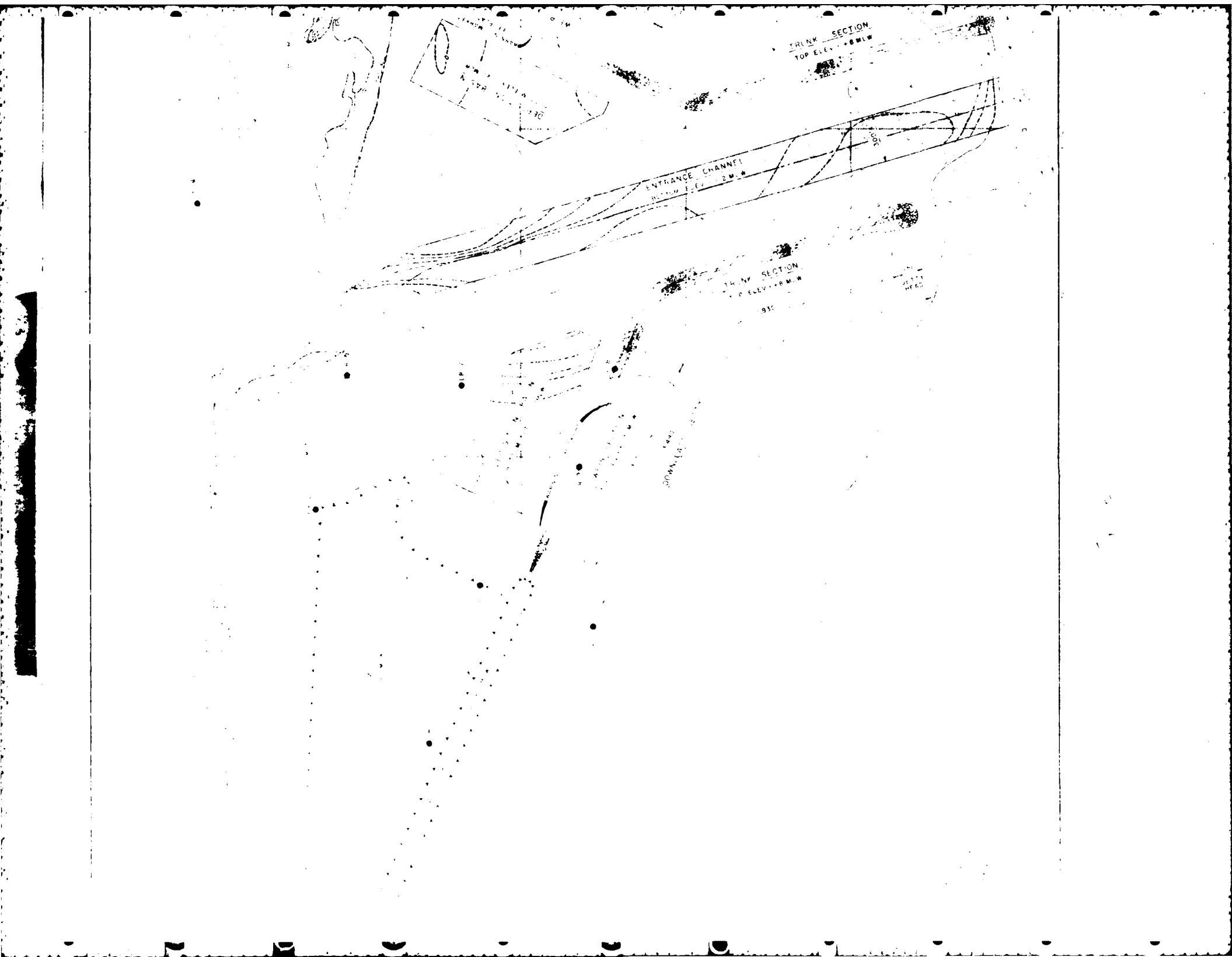
GENERAL PLAN

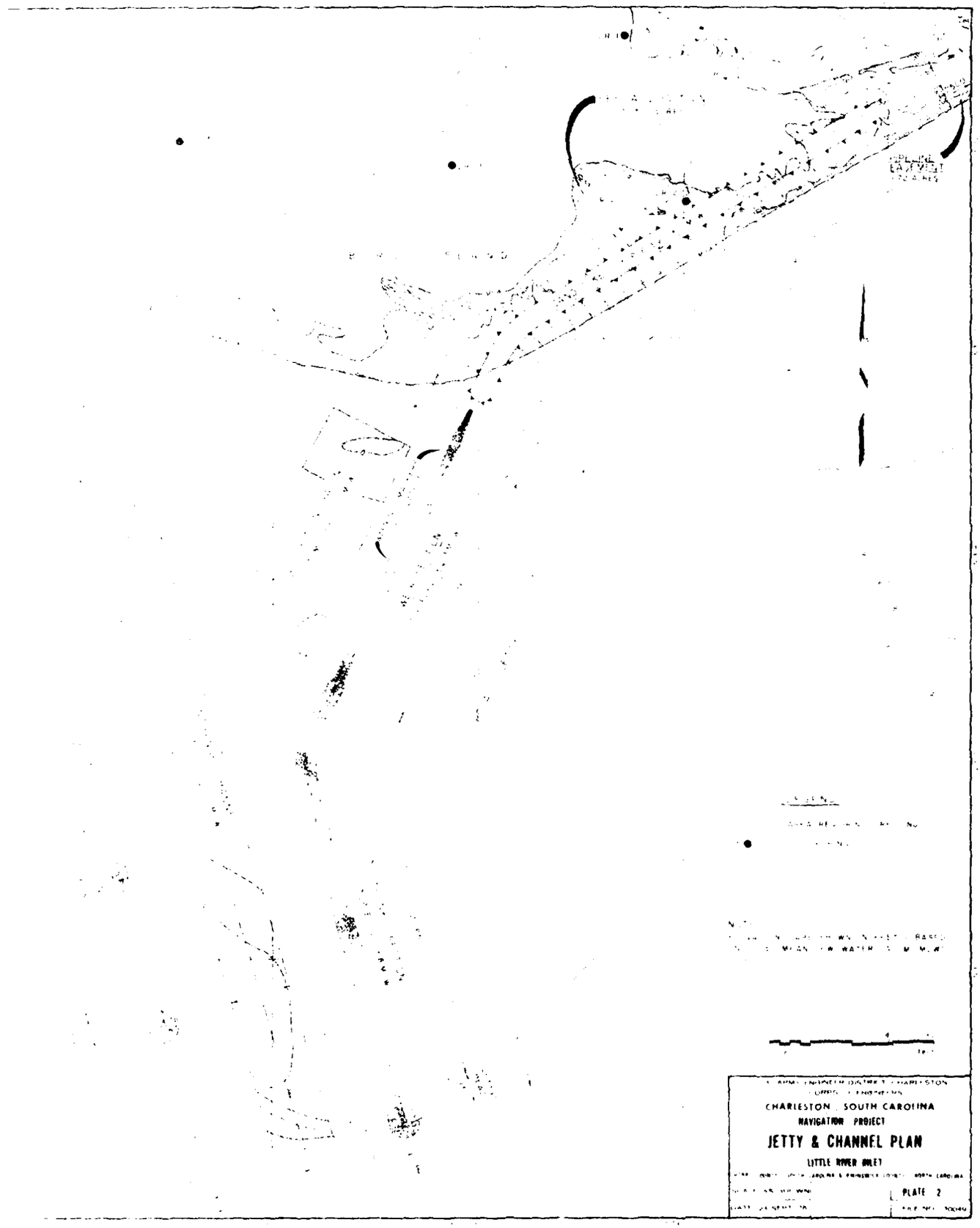
LITTLE RIVER INLET

HORRY COUNTY, SOUTH CAROLINA & BRUNSWICK COUNTY, SOUTH CAROLINA

PLATE 1


M L W .00
90 INNER CHANNEL
100 ENTRANCE CHANN
TYPICAL CHANNEL


TRUNK SECTION
TOP ELEV. +8 M.L.W.
ENTRANCE CHANNEL
TRUNK SECTION



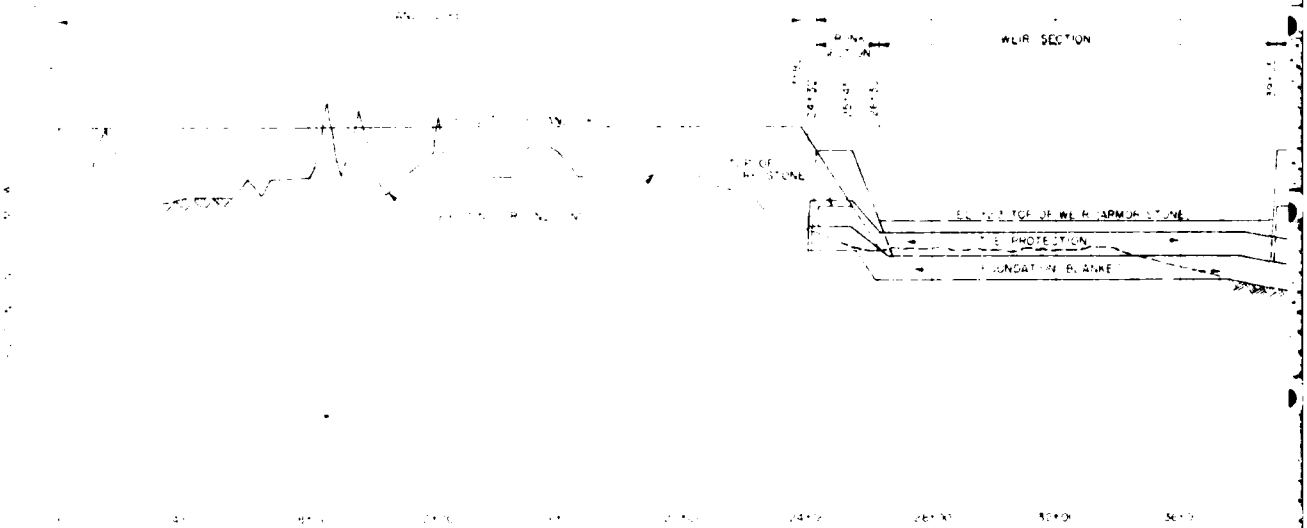
CHARLESTON, SOUTH CAROLINA

NAVIGATION PROJECT

JETTY & CHANNEL PLAN

LITTLE RIVER INLET

PLATE 2

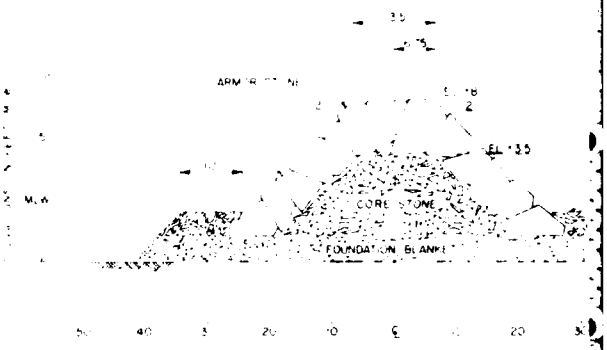


UPCOAST JETTY PROFILE

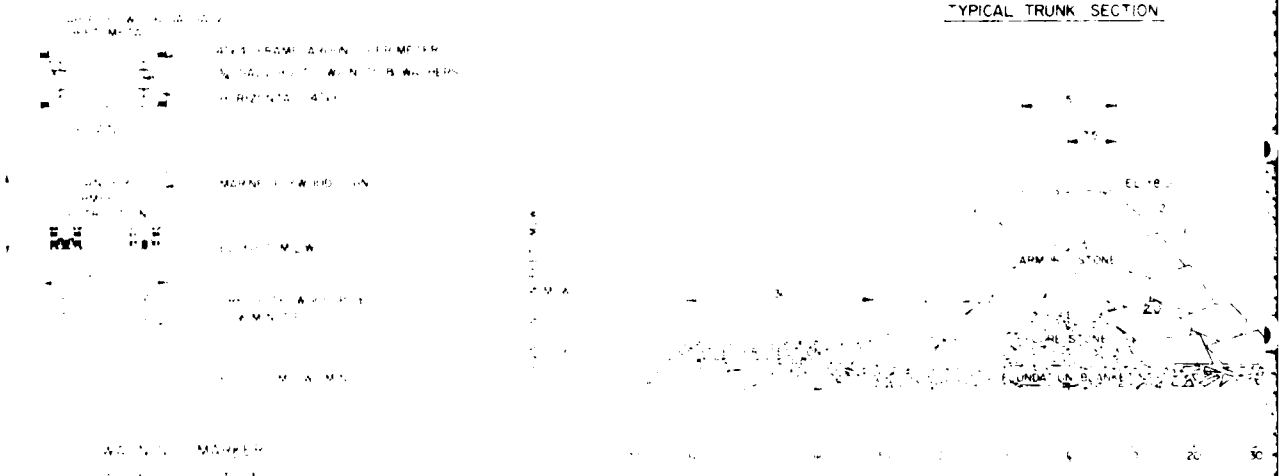
JETTY STONE*

	WEIGHT IN	SIZE IN
ARMOR HEAD		
ARMOR TRUNK		
ARMOR ROOT		
SECONDARY PROTECTION		
FOUNDATION BLANKET		

* ASSUMED UNIT WEIGHT 160 LBS PER CUBIC FOOT SSD

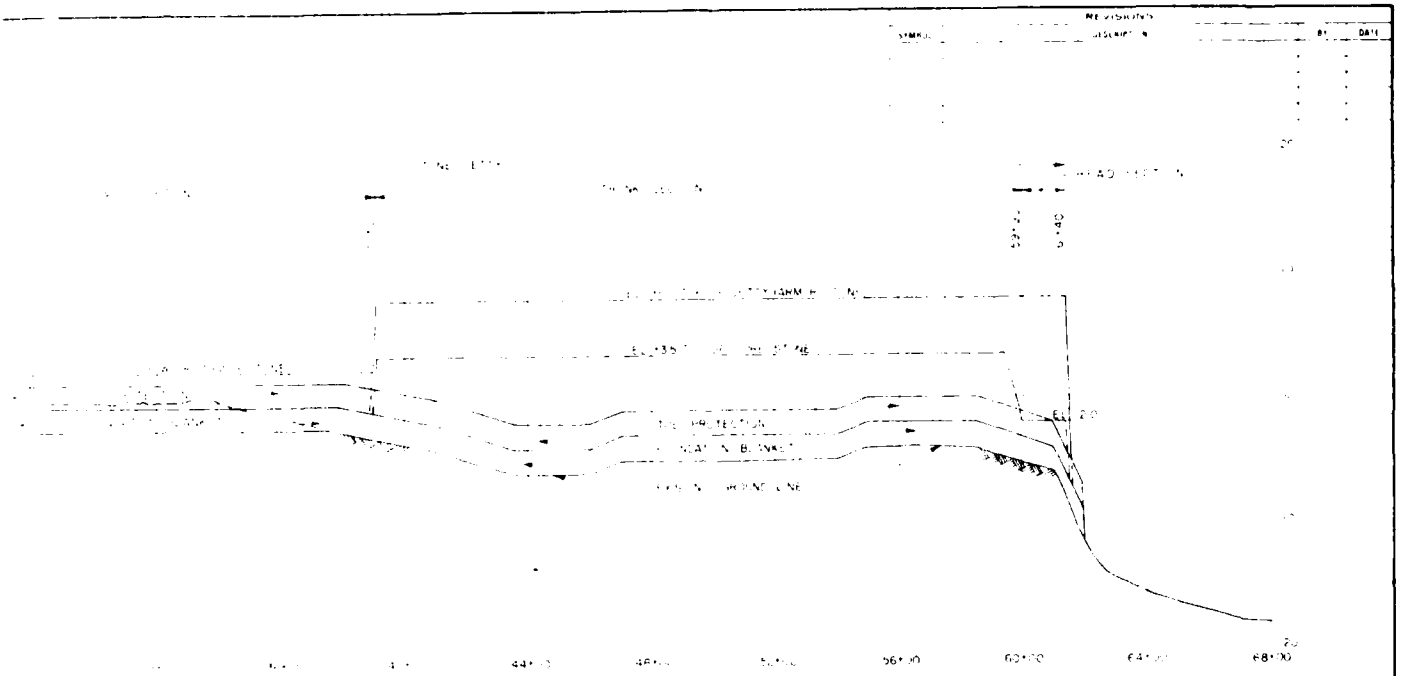


TYPICAL TRUNK SECTION

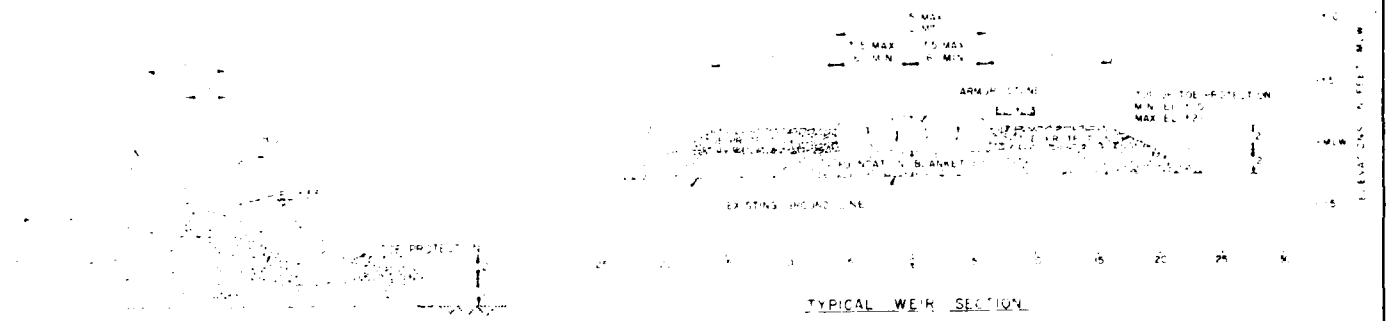


TYPICAL HEAD SECTION

1 of 2



PROFILE



TYPICAL WEIR SECTION

TYPICAL SAND LIKE SECTION

ARMY ENGINEER DISTRICT, CHARLESTON
CORPS OF ENGINEERS
CHARLESTON, SOUTH CAROLINA

NAVIGATION PROJECT

UPCOAST JETTY PROFILE & JETTY SECTIONS

LITTLE RIVER INLET

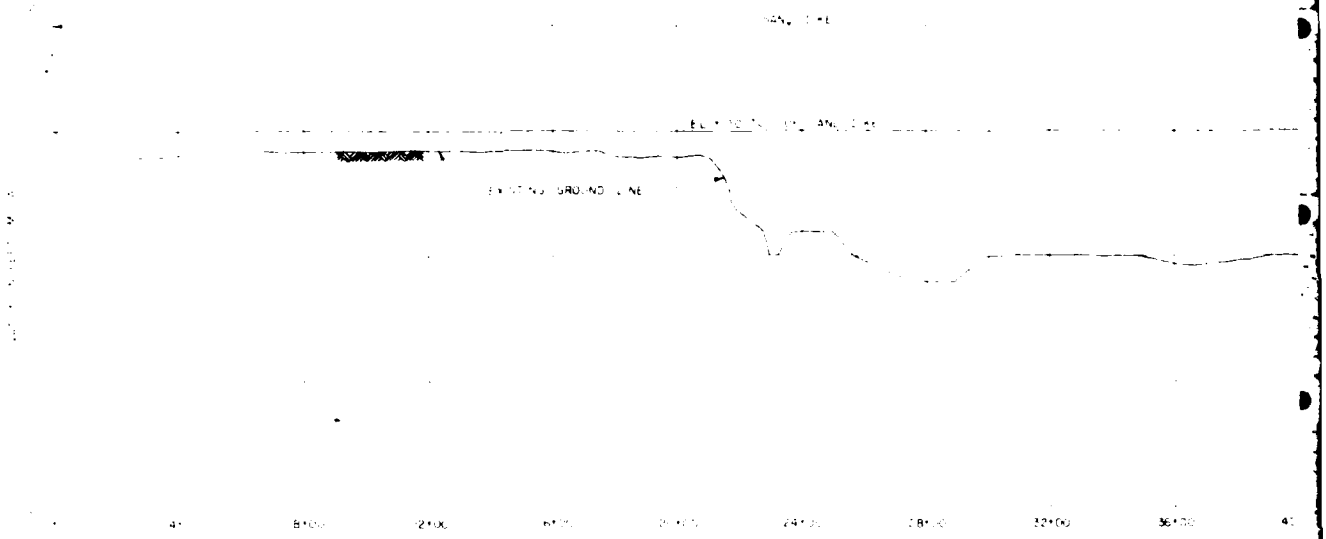
HORRY COUNTY, SOUTH CAROLINA & BRUNSWICK COUNTY, NORTH CAROLINA

SCALE AS SHOWN

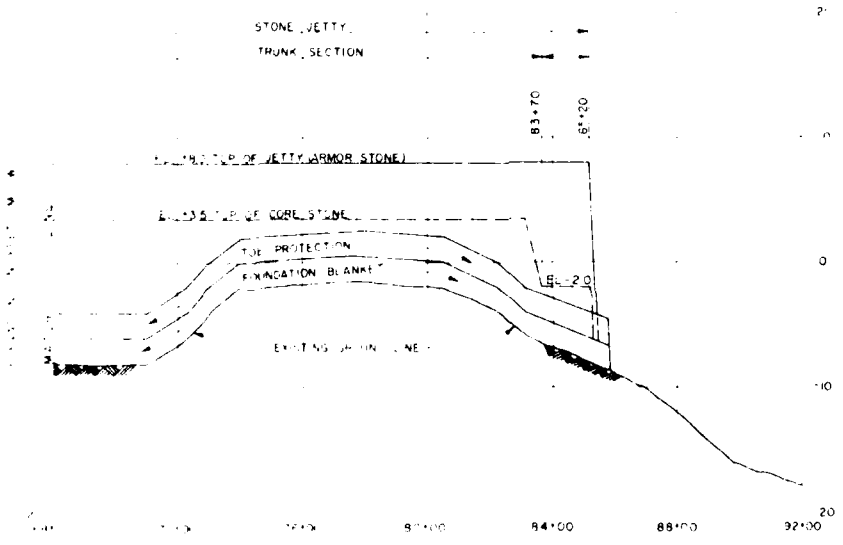
DATE 26 SEPT 1978

PLATE 3

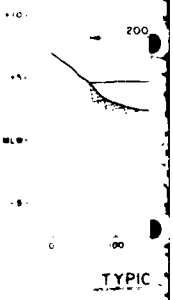
FILE NO 10065



DOWNCOAST JETTY PROFILE



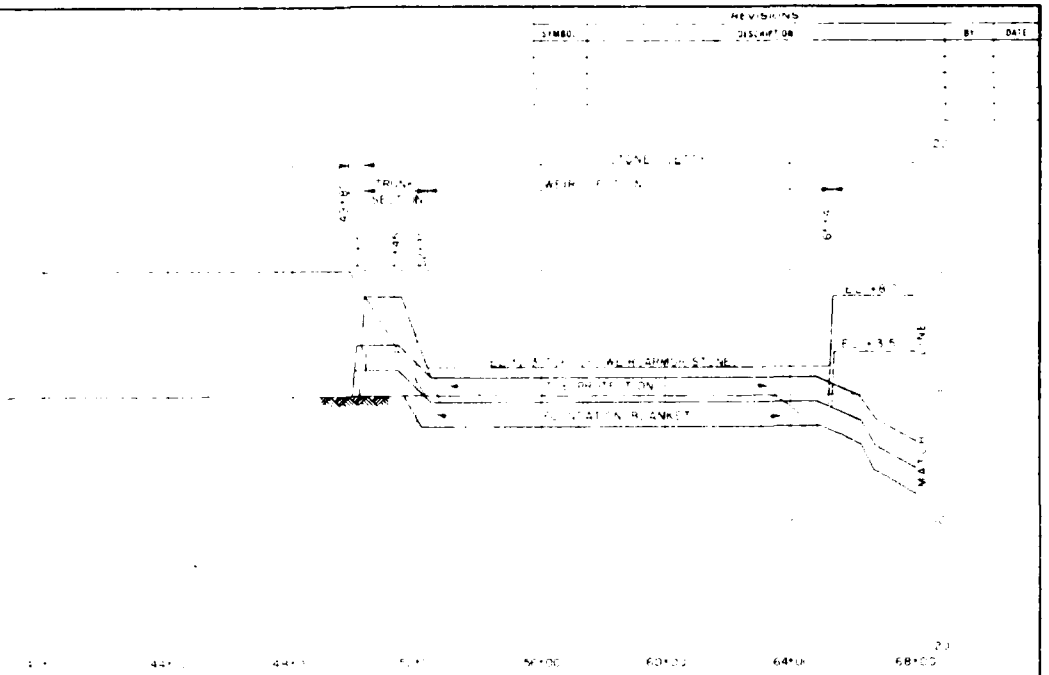
DOWNCOAST JETTY PROFILE



TYPIC

Plate 4

1 of 2



TYPICAL SECTION — NOURISHMENT AREAS

U.S. ARMY CORPS OF ENGINEERS
CHARLESTON DISTRICT
CHARLESTON, SOUTH CAROLINA

NAVIGATION PROJECT

DOWNCOAST JETTY PROFILE

LITTLE RIVER INLET

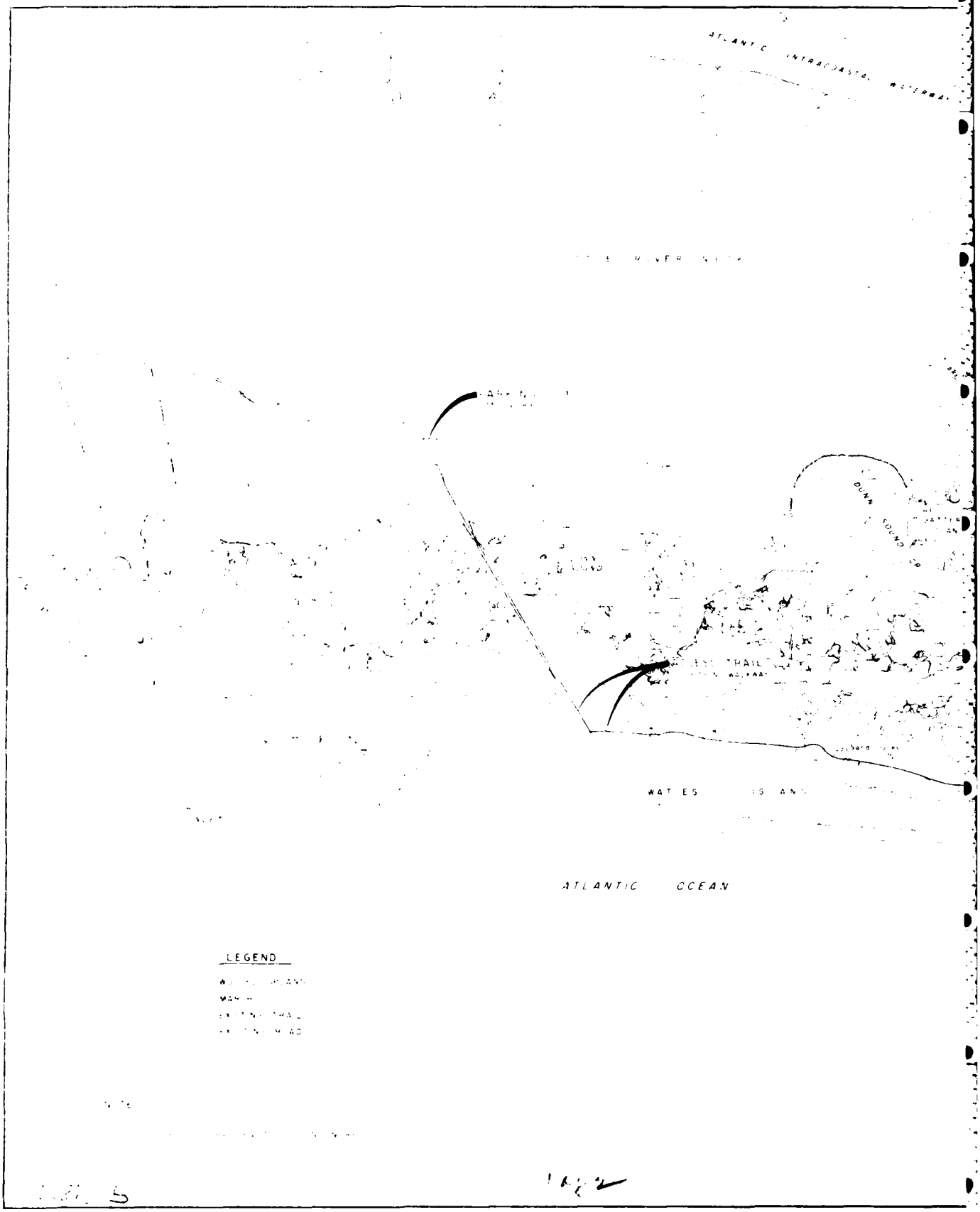
HORRY COUNTY, SOUTH CAROLINA & BRUNSWICK COUNTY, NORTH CAROLINA

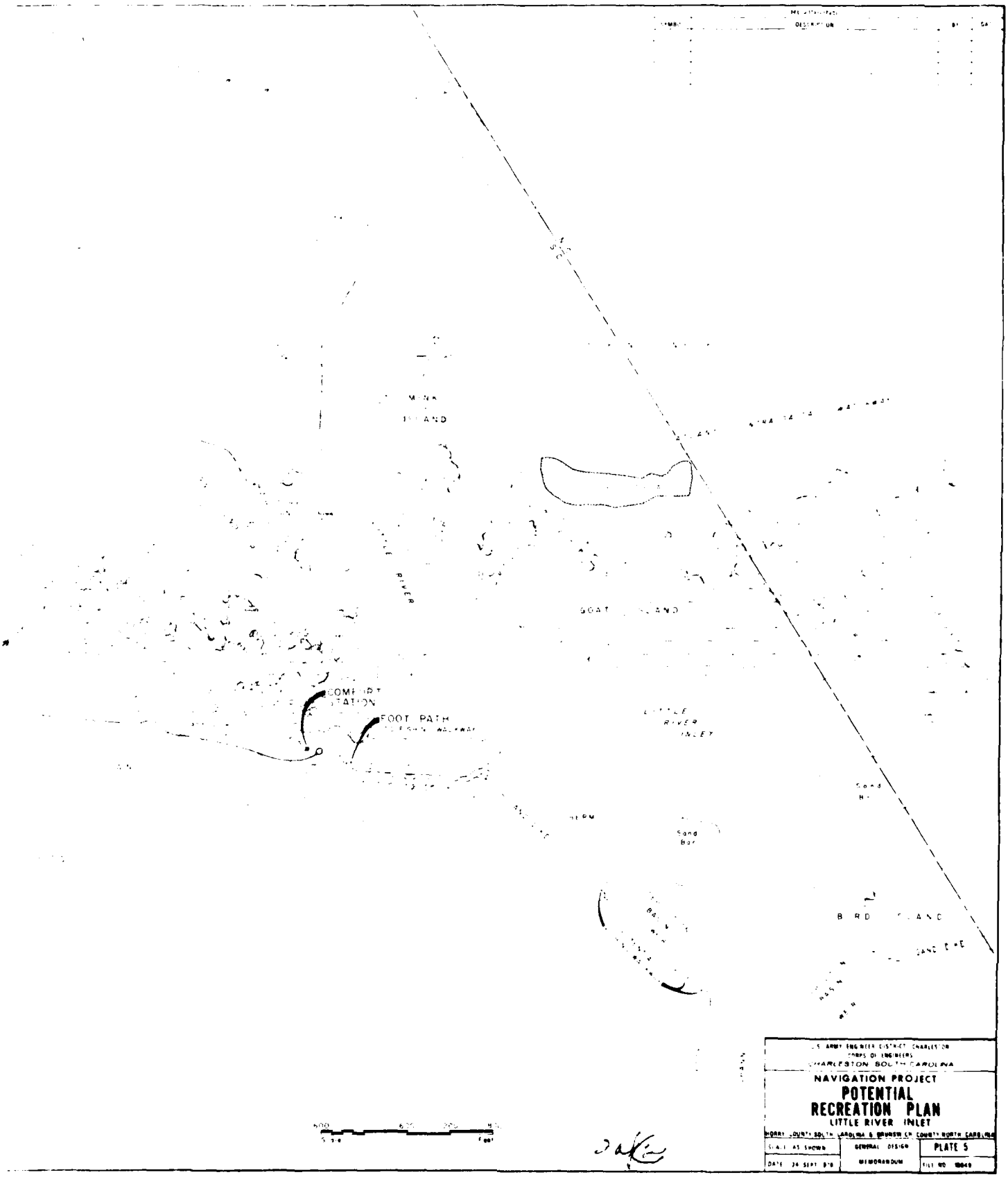
SCALE: AS SHOWN

DATE: 26 SEPT 1975

PLATE 4

FILE NO. 10040


ATLANTIC INTRACOASTAL WATERWAY
DUNN SOUND
ATLANTIC OCEAN
LEGEND



U.S. ARMY ENGINEER DISTRICT, CHARLESTON
CORPS OF ENGINEERS
CHARLESTON, SOUTH CAROLINA

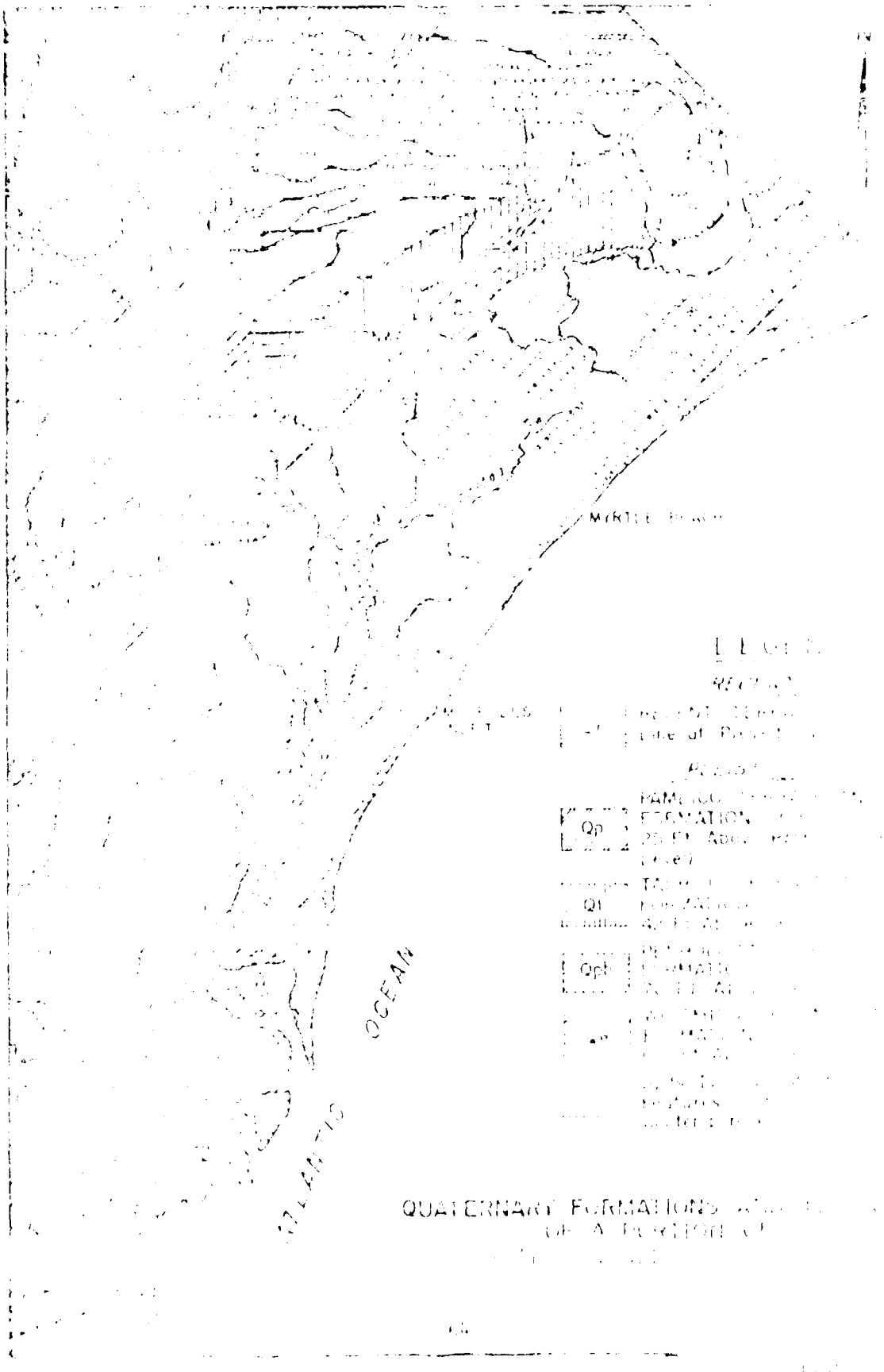
NAVIGATION PROJECT

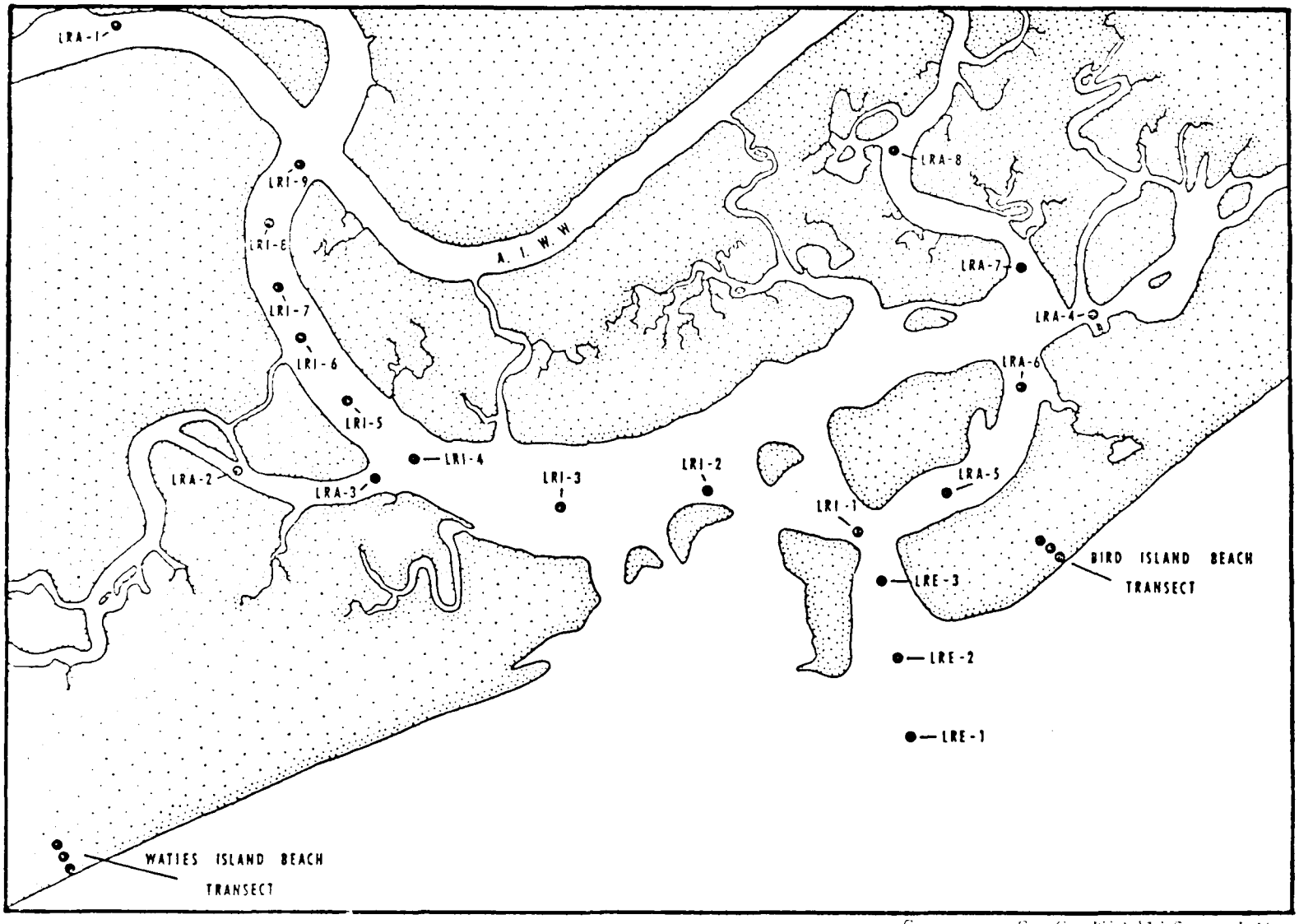
POTENTIAL RECREATION PLAN

LITTLE RIVER INLET

HORRY COUNTY, SOUTH CAROLINA & BRUNSWICK COUNTY, NORTH CAROLINA

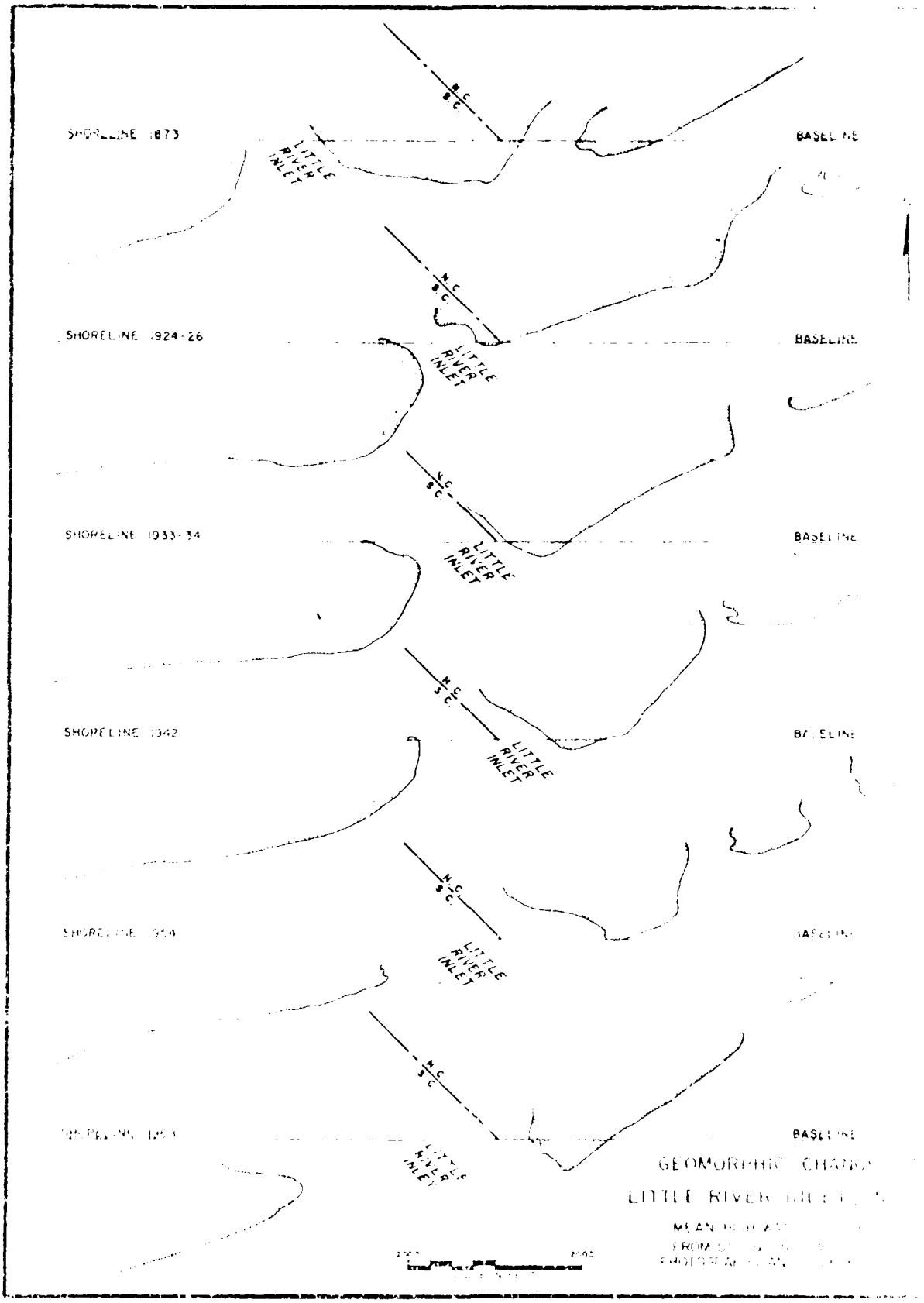
SCALE AS SHOWN	GENERAL DESIGN	PLATE 5
DATE 24 SEPT 68	MEMORANDUM	FILE NO 6848


MYRTLE BEACH
OCEAN
ATLANTIC
Qp
Qt
Qpb

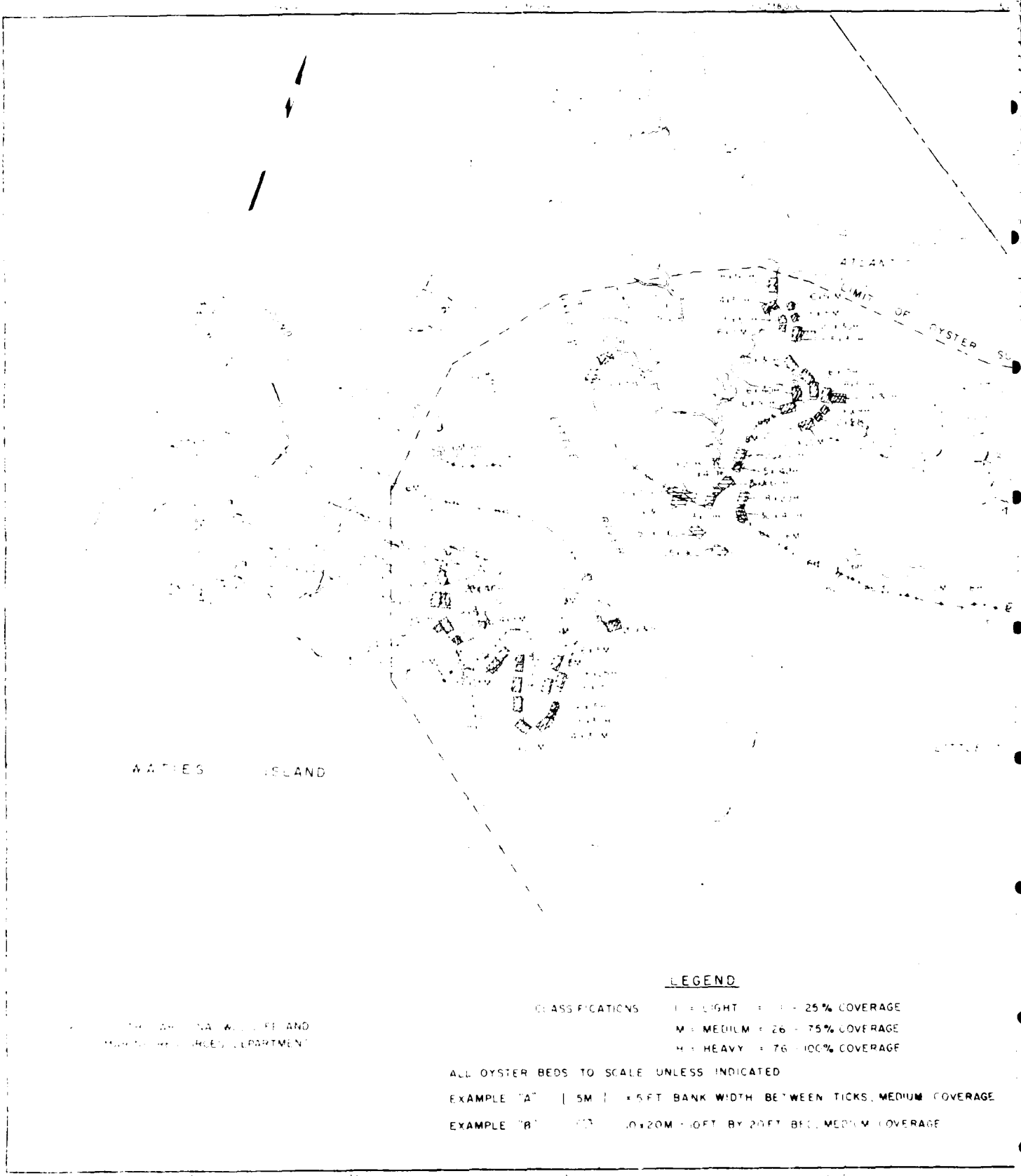


Source: S. C. Wildlife and Marine Resources Department

Ierthic sampling stations in the Little River Inlet area.


N C
S C
SHORELINE 1873
BASELINE
LITTLE RIVER INLET
SHORELINE 1924-26
SHORELINE 1933-34
SHORELINE 1942
BASELINE
GEOMORPHIC CHANGE
LITTLE RIVER INLET

Plate



LEGEND

CLASSIFICATIONS L = LIGHT = 1 - 25% COVERAGE
M = MEDIUM = 26 - 75% COVERAGE
H = HEAVY = 76 - 100% COVERAGE

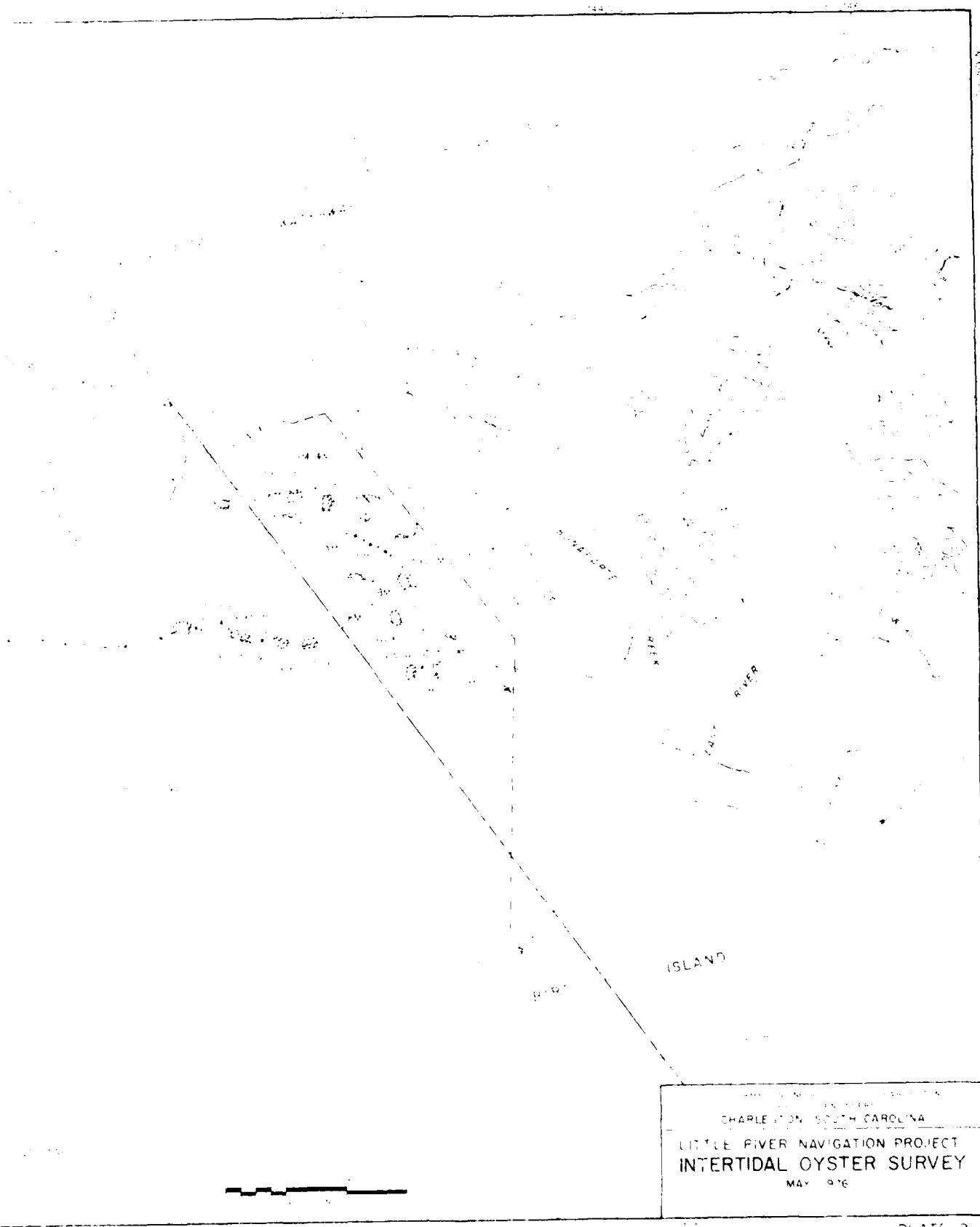
ALL OYSTER BEDS TO SCALE UNLESS INDICATED

EXAMPLE "A" | 5M | = 5 FT BANK WIDTH BETWEEN TICKS, MEDIUM COVERAGE

EXAMPLE "B" 20x20M = 60FT BY 20FT BED, MEDIUM COVERAGE

Title 9

1416



CHARLESTON, SOUTH CAROLINA

LITTLE RIVER NAVIGATION PROJECT

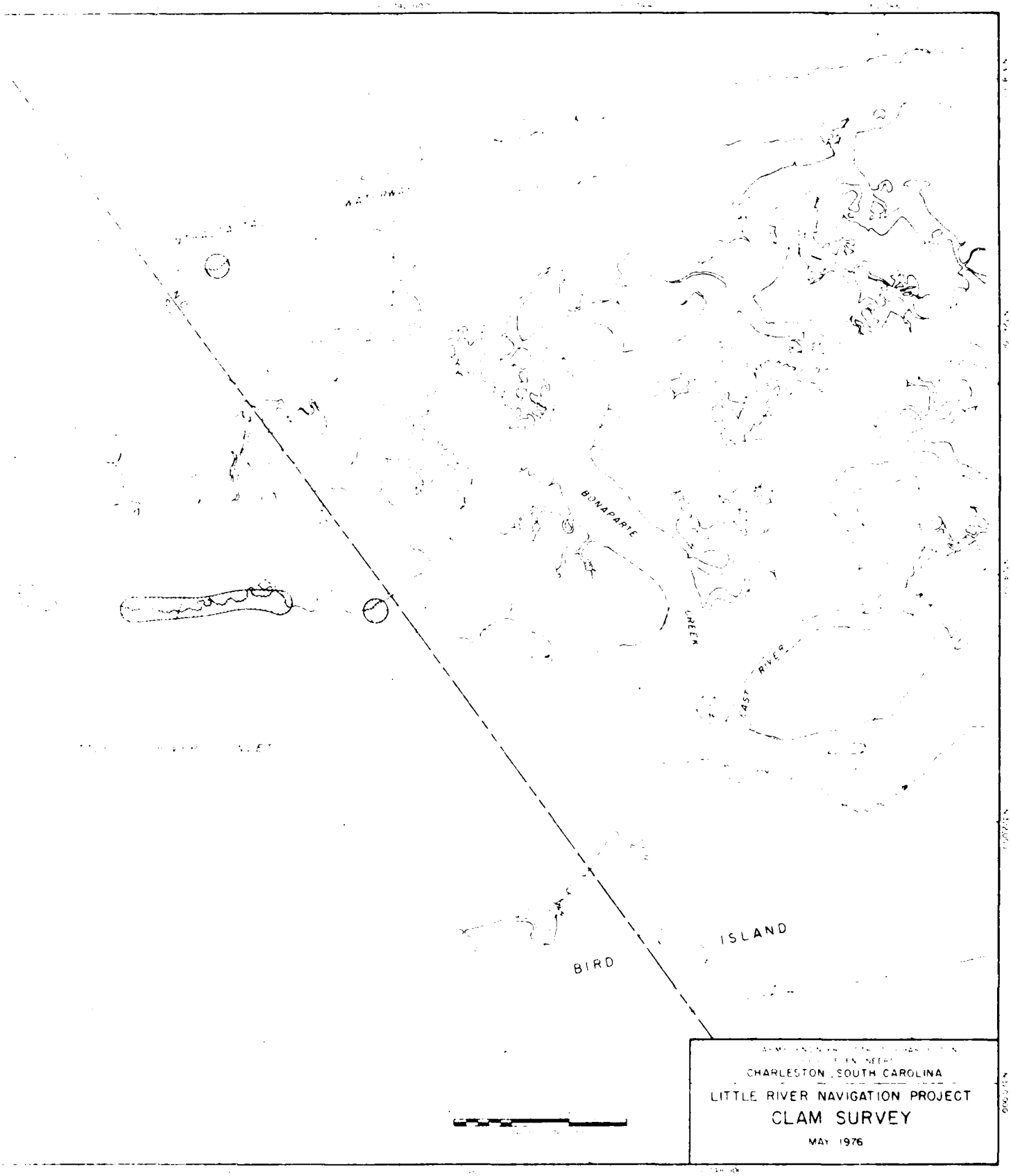
INTERTIDAL OYSTER SURVEY

MAY 1976

PLATE 9

246


ATLANT
LITTLE
RIVER
ISLAND
LEGEND



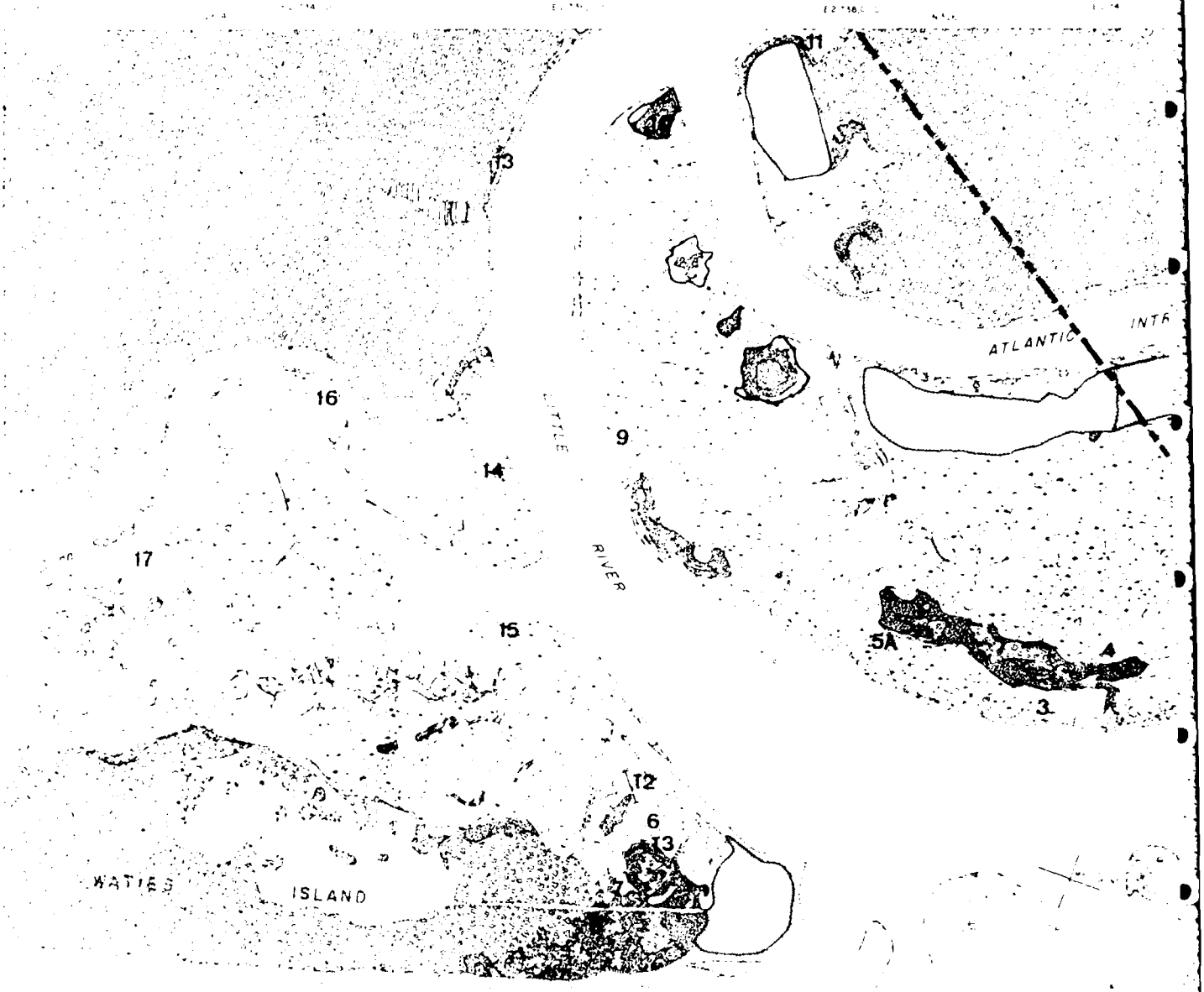
CHARLESTON, SOUTH CAROLINA

LITTLE RIVER NAVIGATION PROJECT

CLAM SURVEY

MAY 1976

PLATE 10



LITTLE RIVER NAVIGATION PROJECT

WETLANDS MAP

OPEN SAND (beaches,dunes,highland)

FORMER OPEN MARSH DISPOSAL AREA

WETLANDS SAMPLING STATIONS

WETLANDS SAMPLING TRANSECTS

DISPOSAL AREA

OPEN WATER

INTERTIDAL SAND

MUDFLATS

N

PLATE 11

TABLE 1

SOIL TEST RESULTS - LITTLE RIVER INLET

BOR. NO.	SAMP. NO.	DEPTH TOP	DEPTH BOT.	SOIL CLASS.	MECH. ANAL. (% PASSING) #4	#10	#40	#200
LR-1	1	0.0	1.5	SP				
"	2	4.5	6.0	SP	100	100	59	3
"	4	36.0	37.5	SC	100	97	60	13
"	5	39.0	40.5	CH	-	-	-	-
LR-2	2	15.0	16.5	SP	100	100	96	4
LR-3	1	0.0	1.5	SP - SM				
"	2	4.5	6.0	SP - SM	-	-	-	-
"	4	13.5	15.0	SP - SM	-	-	-	-
LR-4	1	0.0	1.5	SP - SM	100	99	88	5
"	2	4.5	6.0	SP - SM	-	-	-	-
"	3	9.0	10.5	SP - SM	100	99	84	
LR-5	3	9.0	10.5	SP	99	99	96	4
"	4	15.0	16.5	SP - SM	-	-	-	-
"	6	24.0	25.5	SP - SM	-	-	-	-
LR-6	2	4.5	6.0	SP - SM	-	-	-	-
"	3	9.5	10.5	SP	99	99	98	1
"	4	15.0	16.5	SP - SM	100	100	96	6
LR-7	1	0.0	1.5	SP - SM	-	-	-	-
"	3	9.0	10.5	SP - SM	-	-	-	-
"	4	15.0	16.5	SP - SM	-	-	-	-
LR-8	1	0.0	1.5	SP - SM	-	-	-	-
"	4	15.0	16.5	SP - SM	-	-	-	-
LR-9	1	0.0	1.5	SP	100	100	92	5
"	2	4.5	6.0	SP - SM	-	-	-	-
LR-10	1	0.0	1.5	SP - SM	-	-	-	-
"	2	4.5	6.0	SP	100	99	93	4
"	4	15.0	16.5	SP	99	99	91	4
LR-11	1	0.0	1.5	SP - SM	100	99	99	
"	2	4.5	6.0	SP	-	-	-	-
"	3	9.0	10.5	SP - SM	96	89	86	
"	4	15.0	16.5	SP - SM	-	-	-	-
LR-12	2	4.5	6.0	SP - SM	-	-	-	-
"	3	9.0	10.5	SP - SM	-	-	-	-
"	5	19.5	21.0	SP - SM	-	-	-	-
LR-13	1	0.0	1.5	SP - SM	-	-	-	-
"	2	4.5	6.0	SP	98	97	5	
"	4	15.0	16.5	SP - SM	99	99	4	
"	5	19.0	21.0	SP - SM	-	-	-	-
"	6	24.0	25.5	SM	-	-	-	-
"	8	34.5	36.0	SM	-	-	-	-
"	9	39.0	40.5	SM	100	100	44	

Table 2 Chemical analysis of sediment samples from Little River Inlet. Values are expressed as percent by weight (dry basis).

	LRE-2	LRI-1	LRI-3	LRI-5	LRI-7	LRI-
Volatile Solids (Max. 6.0)	1.06	0.43	0.68	1.11	1.10	2.0
T.V.S. Formula EC	1.60	1.36	1.42	2.45	1.96	1.89
Total Organic Carbon	< 0.10	< 0.10	< 0.10	0.40	0.20	0.21
C.O.D., (Max. 5.0)	0.29	0.40	0.10	1.15	0.65	0.58
Nitrogen, Kjeldahl (Max. 0.10)	0.042	0.050	0.046	0.066	0.048	0.04
Oil and Grease (Max. 0.15)	0.025	0.022	0.020	0.028	0.049	0.0
Lead (Max. 0.005)	0.0005	< 0.0005	< 0.0005	0.0011	0.0013	0.0
Zinc (Max. 0.005)	0.0011	0.0005	0.0006	0.0013	0.0007	0.0
Mercury (Max. 0.0001)	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.0
Total P as PO_4	0.07	0.04	0.04	0.06	0.07	0.05
Iron	0.355	0.075	0.165	0.460	0.220	0.2
Cadmium	< 0.00005	< 0.00005	< 0.00005	0.00008	0.00006	0.0
Arsenic	0.00012	0.00009	0.00005	0.00013	0.00005	0.0
Chromium	0.00100	0.00040	0.00060	0.00140	0.00090	0.0
Nickel	0.00050	< 0.00050	< 0.00050	0.00080	< 0.00050	0.0
Copper	0.00056	0.00034	0.00038	0.00124	0.00042	0.0
Beryllium	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.
Selenium	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.
Vanadium	0.0008	< 0.0005	< 0.0005	0.0017	0.0010	0.0

[illegible] collected during routine studies in the [illegible] area.

Station	Date	Depth	Temp. (C)	Salinity (‰)	Diss. O2 (mg/l)	pH	Solids (mg/l) Suspended	Solids (mg/l) Settleable	Nutrients (µg/l) NO3	NO2	PO4	NH3
LRI-1	21-IV-76	Surface	21.8	33.25	7.8	8.7	-	-	11.4	3.8	18.0	166.6
		Bottom	18.5	33.96	6.5	15.3	-	-	2.7	1.5	6.5	119.4
LRI-1	28-IV-76	Surface	22.5	33.14	7.8	8.8	-	-	2.0	0.8	6.5	91.3
		Bottom	22.0	33.70	7.6	3.8	-	-	2.8	1.0	25.5	42.2
	21-IV-76	Surface	22.8	32.75	7.8	8.2	-	-	-	-	10.5	70.2
		Bottom	22.6	33.25	7.8	8.7	-	-	1.6	0.8	9.0	77.3
LRI-3	21-IV-76	Surface	21.2	33.71	7.9	8.1	54.0	61.2	10.1	0.7	19.5	35.1
		Bottom	20.9	33.74	7.7	8.2	-	-	6.2	0.8	12.0	42.2
	21-IV-76	Surface	22.7	32.97	7.6	8.1	-	-	-	-	10.5	84.3
		Bottom	22.4	33.13	7.7	8.7	-	-	22.1	1.0	7.0	119.4
LRI-7	28-IV-76	Surface	22.2	29.59	7.2	4.3	50.8	50.8	23.1	1.4	-	259.8
		Bottom	21.7	31.42	7.3	5.0	-	-	6.1	1.3	10.5	17 [illegible]
	21-IV-76	Surface	22.7	32.00	7.6	8.8	-	-	2.1	1.7	16.5	140.5
		Bottom	22.3	33.02	7.4	8.4	-	-	7.4	1.0	9.0	2
LRI-9	28-IV-76	Surface	24.4	25.56	6.9	5.4	64.4	20.4	31.8	2.5	42.0	456.6
		Bottom	23.5	26.21	7.2	5.1	99.8	12.8	15.4	2.4	18.0	330.2
	21-IV-76	Surface	23.2	31.00	7.4	4.4	73.6	2.4	-	-	10.5	111.4
		Bottom	22.8	32.81	7.3	5.3	-	-	-	-	7.5	70.2

Source: S. C. Wildlife and Marine Resources Department

Table

[illegible] Invertebrates Collected on Gravel [illegible]
[illegible] and Beaches at Port Estimate, Louisiana
[illegible] Estimates were based on [illegible] Samples
[illegible] Stations, One at High Tide, One at Mid-Tide,
and One at Low Tide

[illegible]

Bird Island

[illegible]	High Tide	Mid-Ti	[illegible]
[illegible]		355	[illegible]
[illegible]		140	[illegible]
[illegible]		70	135
[illegible]		65	[illegible]
[illegible]			15
[illegible]		20	
[illegible]		10	[illegible]
[illegible]			1
[illegible]			10
[illegible]			10
[illegible]	5		
[illegible]			5
[illegible]	5	655	615
[illegible]	1	6	10
[illegible]	0.00	0.77	1.50
[illegible]	0.09	1.86	[illegible]

[illegible]

[illegible]		[illegible]5	465
[illegible]	10	5	21
[illegible]	5	205	[illegible]
[illegible]		135	[illegible]
[illegible]		5	[illegible]
[illegible]	5	5	
[illegible]			
[illegible]	20	[illegible]5	[illegible]
[illegible]	5	[illegible]	[illegible]
[illegible]	0.17	[illegible]	
[illegible]	[illegible]	[illegible]	

[illegible]

Table 5. Species of macroinvertebrates collected in the entrance channel, and their estimated densities in numbers m^{-2}. Estimates were based on two 0.13 m^2 samples at each of three stations:

A = amphipod, D = decapod, B = bivalve, P = polychaete, G = gastropod, E = echinoderm, I = isopod

Species	LRE-1	LRE-2	LRE-3
Spiophanes bombyx (P)		354	
Parahaustorius longimerus (A)			177
Neohaustorius schmitzi (A)			158
Magelona sp. (P)	131	8	4
Tellina sp. (B)	46	73	
Clymenella torquata (P)	54	19	
Hemipholis elongata (E)		58	
Glycera dibranchiata (P)	15	35	
Paraprionospio pinnata (P)	31	19	
Nemertina (undet.)	19	15	
Heteromastus filiformis (P)		35	
Polychaeta (undet.)	12	23	
Sigambra bassi (P)	8	23	
Turbonilla interrupta (G)	27		
Aglaophamus verrilli (P)	12	12	
Pectinaria gouldii (P)	19	4	
Ensinoca solitaria (G)	12	8	
Nereis succinea (P)	4	15	
Batea catharinensis (A)	4	15	
Corophium sp. (A)	4	15	
Etcone sp. (P)		15	
Diopatra cuprea (P)		12	

Table 5. (continued)

Species	LRE-1	LRE-2	LRE-3
Sabellaria vulgaris (P)		12	
Axidara ovalis (B)		12	
Notomastus hemipodus (P)		8	
Nephtys bucera (P)	4	4	
Lycastopsis sp. (P)	8		
Eteone heteropoda (P)		8	
Spio sp. (P)		8	
Busycon carica (G)		8	
Brachidontes exustus (B)		8	
Molinia lateralis (B)		8	
Edotea montosa (I)		8	
Microprotopus shoemakeri (A)	8		
Pinnixa retinens (D)	8		
Leptosynapta inhaerens (E)	8		
Arenicola marina (P)	4		
Haploscoloplos fragilis (P)		4	
Owenia fusiformis (P)	4		
Sthenelais boa (P)		4	
Spio setosa (P)	4		
Polinices duplicatus (G)		4	
Mitrella lunata (G)	4		
Terebra dislocata (G)		4	
Nucula proxima (B)	4		
Anadara sp. (B)		4	
Donax variabilis (B)			4
Pelecypoda A (undet.)			4
Pelecypoda B (undet.)	4		

(Continued)

[illegible]	LRE-1	LRE-2	[illegible]
[illegible] (1)			4
[illegible] (2)			4
[illegible] (3)			4
[illegible] (1)		4	
[illegible] (2)	4		
[illegible] (adult)		4	
[illegible] (juvenile)	4		
[illegible] (adult)		4	
No. Individuals	466	874	359
No. Species	28	37	8
Species Richness	4.39	5.32	1.19
Species Diversity (H')	3.86	3.73	1.46

Source: S. C. Wildlife and Marine Resources Department

Table 6. Benthic invertebrates from dredge collections at three stations in the Entrance Channel.

Species	LRE-1	LRE-2	LRE-3
Phylum Coelenterata			
Rhopilema verrilli (polyp)			+
Phylum Annelida			
Sabellaria vulgaris		+	
Phylum Mollusca			
Brachidontes exustus			+
Mercenaria mercenaria		+	
Crassostrea virginica	+	+	
Phylum Arthropoda			
Balanus amphitrite		+	
Balanus sp. (cyprids)			+
Portunus gibbesi	+	+	
Portunus spinimanus	+		
Phylum Hemichordata			
Balanoglossus aurantiacus	+		
No. species	4	5	3

Source: S. C. Wildlife and Marine Resources Department

Table 7. Species of macroinvertebrates collected in the inner channel, and their [illegible] densities in numbers m^{-2}. Estimates were based on two 0.13 m^2 samples [illegible] nine stations.

A = amphipod, P = polychaete, B = bivalve, D = decapod, E = echinoderm, I [illegible], Ba = barnacle, F = Flatworm

Species	LRI-1	LRI-2	LRI-3	LRI-4	LRI-5	LRI-6	LRI-7	LRI-8	LRI-9
Ne[illegible]rotius sch[illegible]i (A)		262	782	358					
Spi[illegible]es bombyx (P)			12		42	139	127	52	2[illegible]
Be[illegible] [illegible]ilicorn[illegible] (P)					12	123	54	19	244
Nete[illegible] [illegible] (P)					8	54	42	27	109
Pa[illegible] [illegible] (A)	62		131	39					
Le[illegible] [illegible] (A)	154	35		12					
Polychaete (undet.)					12	62		1[illegible]	[illegible]
Br[illegible] (P)			27		4		4	[illegible]	
Ne[illegible] (P)						8	12	4	58
Spio setosa (P)							4	4	23
Polydo[illegible] (P)								12	42
Glycera dibranchiata (P)						15	8	12	35
Streblospio benedicti (P)							31	15	15
Mesocrania americana (P)					4		12	19	19
Monoculodes (undet.)					12	15		4	19
[illegible] (A)					4	23		[illegible]	[illegible]
Pagurus [illegible] (D)		35							
Ampelisca (undet.)					4	23			[illegible]
Cyclaspis [illegible] (P)						8			[illegible]
Mollusc [illegible] (B)									31
Sabellaria [illegible] (P)							8	3	15
Polychaeta (undet.)							12		12

Table 7. (continued)

Species	LRI-1	LRI-2	LRI-3	LRI-4	LRI-5	LRI-6
Hemipholis elongata (E)						
Etgone lactea (P)				4		
Nucula sp. (B)					15	
Pectinaria gouldii (P)					8	
Scalework (unlet.)					8	
Amphitrite sp. (P)						
Tellina sp. (B)		8	4	4		
Autolytus sp. (P)						
Phyllodoce sp. (P)						
Solen viridis (B)						
Magelona sp. (P)		4	8			
Ampelisca vadorum (E)						
Mysid (unlet.)			12			
Nephtys bucera (P)				8		
Ariciidae sp. (P)				8		
Sabellaria vulgaris (P)						
Nucula proxima (B)						
Cyathura burbancki (I)					8	
Caprellidae sp. (E)		8				
Idotea baltica (E)						
Styela partita (E)		4				
Nereitina (unlet.)						
Glycera americana (P)				4		
Diopatra cuprea (P)						
Etgone hebes pelta (P)						
Pagurid (unlet.)						

AD-A149 773 LITTLE RIVER INLET NAVIGATION PROJECT BRUNSWICK COUNTY 2/2
NORTH CAROLINA AND.. (U) CORPS OF ENGINEERS CHARLESTON
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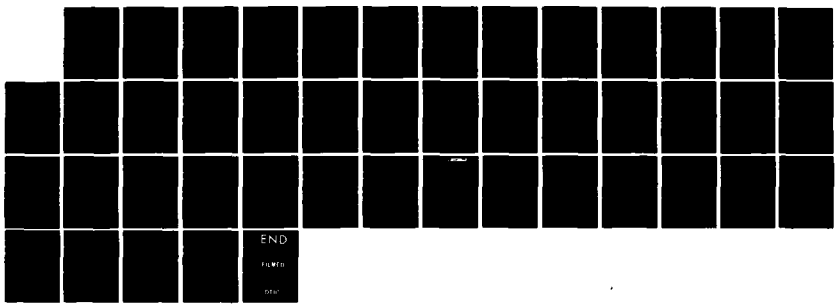


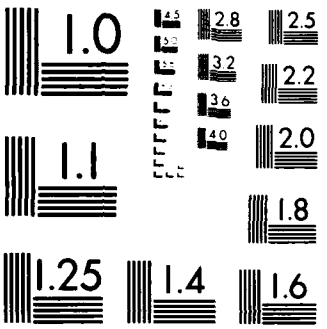


Table 7. (continued)

Species	LRI-1	LRI-2	LRI-3	LRI-4	LRI-5	LRI-6	LRI-7	LRI-8	LRI-9
Sigambra bassi (P)							4		
Sabella microphthalma (P)									
Spio sp. (P)					4				
Mulinia lateralis (B)					4				
Abra lioica (B)					4				
Balanus improvisus (Ba)					4				
Unciola serrata (A)					4				
Paracaprella tenuis (A)					4				
Amphipod (undet.)							4		
Clibanarius vittatus (D)									4
Pagurus sp. (D)					4				
No. Individuals	216	332	976	433	158	517	365	336	1182
No. Species	2	3	8	6	21	15	20	19	27
Species Richness	0.19	0.34	1.02	0.82	3.95	2.24	3.22	3.09	3.67
Species Diversity (H')	0.86	0.95	1.04	1.00	3.89	3.11	3.31	3.45	3.58

Source: S. C. Wildlife and Marine Resources Department

Table 8. Benthic invertebrates from oyster dredge collections at nine stations in the Inner Channel.

Species	LRI-1	LRI-2	LRI-3	LRI-4	LRI-5	LRI-6	LRI-7	LRI-8	LRI-9
Phylum Porifera									
Microciona prolifera		+							
Cliona celata				+	+			+	
Sponge (undet.)		+							
Phylum Cnidaria									
Rhopilema verrilli (polyp)			+	+					
Bougainvillia rugosa				+	+		+		+
Garveia franciscana								+	
Garveia humilis								+	
Amphinema dinema					+				+
Campanulina sp.						+	+		
Obelia dichotoma				+	+	+	+	+	+
Astrangia danae					+				
Anemone (undet.)								+	+
Phylum Platyhelminthes									
Stylochus ellipticus					+	+	+	+	+
Phylum Rhynchocoela									
Nemertine (undet.)					+				
Phylum Entoprocta									
Barentsia gracilis									+
Phylum Bryozoa									
Alcyonidium hauffi					+				

Table 8. (continued)

Species	LRI-1	LRI-2	LRI-3	LRI-4	LRI-5	LRI-6	LRI-7	LRI-8	LRI-9
Anguinella palmata				+	+				
Bowerbankia gracilis					+	+	+	+	
Membranipora arborescens					+				
Membranipora tenuis					+	+		+	+
Conopeum tenuissimum					+		+	+	+
Electra monostachys				+	+		+	+	+
Phylum Annelida									
Notomastus hemipodus								+	
Nereis succinea				+	+		+	+	+
Sabellaria vulgaris					+			+	+
Hydroides dianthus					+			+	+
Syllidae (undet.)								+	
Ampharete sp.								+	
Phylum Mollusca									
Crepidula plana									+
Urosalpinx cinerea						+			
Nudibranch (undet.)		+			+				+
Anadara ovalis								+	
Brachidontes exustus			+		+	+	+	+	+
Lithophaga bisulcata					+				
Modiolus modiolus squamosus					+				
Martesia cuneiformis					+		+		
Crassostrea virginica					+			+	+
Mercenaria mercenaria					+			+	
Bivalve (undet.)								+	

Table 8. (continued)

Species	LRI-1	LRI-2	LRI-3	LRI-4	LRI-5	LRI-6	LRI-7	LRI-8	LRI-9
Phylum Arthropoda									
Balanus amphitrite		+							
Balanus improvisus			+	+	+	+	+	+	+
Cleantis planicauda			+						
Melita nitida									+
Erichthonius brasiliensis					+				
Paracaprella tenuis					+			+	
Clibanarius vittatus			+						
Pagurus longicarpus		+							
Callinectes sapidus							+		+
Hexapanopeus angustifrons		+			+				
Eurypanopeus depressus							+		
Phylum Echinodermata									
Asterias forbesi (juv.)								+	
Phylum Chordata									
Molgula manhattensis				+	+			+	+
No. Species	0	6	5	9	29	8	13	25	20

Source: S. C. Wildlife and Marine Resources Department

Table 9. Species of macroinvertebrates collected in adjacent waterways, and their estimated densities in numbers m^{-2}. Estimates were based on two 0.13 m^2 samples at each of eight stations.

P = polychaete, B = bivalve, A = amphipod, D = decapod, E = echinoderm, G = gastropod, T = tunicate, C = cumacean.

Species	LRA-1	LRA-2	LRA-3	LRA-4	LRA-5	LRA-6	LRA-7	LRA-8
Spiophanes bombyx (P)		42	58	123	139	81	54	424
Nereis succinea (P)	23	23					246	316
Paleanotus obscura (P)		39					331	8
Notomastus hemipodus (P)	23	35			15		85	62
Polychaeta (undet.)	54	23	8	15	12		77	46
Tellina sp. (B)	23	19		4	108	35		
Glycinella tegarta (P)		23		27			100	15
Corophium lacustre (A)	62			12			69	
Nemertina (undet.)	15		8	8	4	8	8	46
Melita nitida (A)	85							
Mercenaria mercenaria (B)	23	19		4			15	15
Autolytus fasciatus (P)		4						69
Nephtys bucera (P)			42		19	12		
Neotrypaea sp. (A)			19		23	31		
Spiophanes bombyx (P)		15		12				39
Barbeitia sp. (P)		4		46				
Paraprionospio pinnata (P)				39	8			
Glycinde solitaria (P)	23			19				
Tagelus divisus (B)	31	4						
Glycera americana (P)				8				23
Anomura (undet.)							8	15
Pennaxius glaber (P)							15	8

Table 9. (continued)

Species	LRA-1	LRA-2	LRA-3	LRA-4	LRA-5	LRA-6	LRA-7	LRA-8
Neopanope sayi (D)		4						15
Spio setosa (P)							15	
Pelecypoda (undet.)		15						
Microprotopus raneyi (A)							15	
Asterias forbesi (E)								15
Hemipholis elongata (E)								15
Pectinaria gouldii (P)				4			8	
Abra lioica (B)				4				8
Glycera sp. (P)		4					4	
Haploscoloplos fragilis (P)	8							
Polydora ligni (P)					4	4		
Pista sp. (P)							8	
Diodora cayenensis (G)							8	
Brachidontes exustus (B)		8						
Spisula sp. (B)							8	
Mulinia lateralis (B)							8	
Chione cancellata (B)								8
Batea catharinensis (A)							8	
Alpheus normanni (D)							8	
Pagurus sp. (D)								8
Portunus sp. (D)								8
Molgula manhattensis (T)							8	
Heteromastus filiformis (P)				4				
Onuphis sp. (P)		4						
Diopatra cuprea (P)					4			
Ampharete sp. (P)				4				

Table 9. (continued)

Species	LRA-1	LRA-2	LRA-3	LRA-4	LRA-5	LRA-6	LRA-7	LRA-8
Gastropod (undet.)				4				
Nucula proxima (B)				4				
Nuculana sp. (B)			4					
Cyclaspis varians (C)				4				
Oxyurostylus smithi (C)					4			
Ampelisca vadorum (A)				4				
Corophium sp. (A)		4						
Trichophoxus epistomus (A)						4		
Protohaustorius deichmannae (A)					4			
Lystriella clymenellae (A)				4				
Monocaloides sp. (A)		4						
Pinnixa chaetopterana (D)					4			
No. Individuals	370	293	139	353	348	175	1106	1163
No. Species	11	19	6	21	13	7	22	20
Species Richness	1.69	3.17	1.01	3.41	2.05	1.16	3.00	2.69
Species Diversity (H')	3.18	3.79	2.06	3.35	2.47	2.14	3.21	2.94

Source: S. C. Wildlife and Marine Resources Department

Table 10. Benthic invertebrates from oyster dredge collections at eight stations in adjacent waterways.

Species	LRA-1	LRA-2	LRA-3	LRA-4	LRA-5	LRA-6	LRA-7	LRA-8
Phylum Porifera								
Cliona celata							+	+
Cliona truitti							+	+
Phylum Cnidaria								
Ectopleura dumortieri				+				+
Turritopsis nutricula							+	+
Hydractiniidae (undet.)							+	
Bougainvillia rugosa		+						
Garveia franciscana		+						
Garveia humilis								+
Amphinema dinema								+
Pandeidae (undet.)		+					+	
Eudendrium sp.							+	+
Clytia cylindrica							+	+
Clytia kincaidi								+
Obelia dichotoma	+	+		+			+	+
Campanulina sp.			+	+				
Campanopsis (?) sp.							+	+
Schizotricha tenella							+	+
Renilla reniformis						+		
Haliplanella luciae							+	
Astrangia danae							+	
Phylum Platyhelminthes								
Stylochus ellipticus	+	+		+			+	+

Table 10. (continued)

Species	LRA-1	LRA-2	LRA-3	LRA-4	LRA-5	LRA-6	LRA-7	LRA-8
Phylum Rhynchocoela								
Nemertine (undet.)							+	
Phylum Entoprocta								
Pedicellina cernua							+	+
Phylum Bryozoa								
Anguinella palmata							+	+
Bowerbankia gracilis							+	+
Aeverrillia setigera							+	
Membranipora tenuis	+	+	+	+			+	+
Conopeum tenuissimum	+	+						
Electra monostachys		+		+				
Bugula neritina				+				
Schizoporella errata							+	
Parasmittina nitida							+	
Phylum Annelida								
Clymenella torquata				+				
Nereis succinea	+	+		+			+	+
Sabellaria vulgaris		+		+			+	+
Hydroides dianthus							+	+
Polydora sp.	+							
Phylum Mollusca								
Diodora cayenensis								+
Urosalpinx cinerea							+	+
Eupleura caudata							+	+

Table 10. (continued)

Species	LRA-1	LRA-2	LRA-3	LRA-4	LRA-5	LRA-6	LRA-7	LRA-8
Busycon carica							+	+
Brachidontes exustus	+	+	+	+				+
Anomia simplex								+
Crassostrea virginica	+	+					+	+
Chione cancellata							+	+
Martesia cuneiformis							+	+
Phylum Arthropoda								
Balanus amphitrite				+				
Balanus improvisus	+	+	+	+			+	+
Erichthonius brasiliensis	+		+					
Paracaprella tenuis							+	+
Alpheus normanni							+	+
Callinectes sapidus			+					+
Panopeus herbstii	+							+
Phylum Echinodermata								
Asterias forbesi							+	+
Ophiothrix angulata							+	
Mellita quinquesperforata					+			
Phylum Chordata								
Molgula manhattensis							+	
No. Species	11	13	6	13	1	1	36	35

Source: S. C. Wildlife and Marine Resources Department

Table 11 List of observed marsh and marsh-bordering plants in the Little River Inlet study area.

Common Name	Scientific Name	Abbreviation	Location
Smooth cordgrass	Spartina alterniflora		low marsh, high marsh
	short form	SSA	
	medium form	MSA	
Marsh-hay cordgrass	Spartina patens	Sp	high marsh, shrub border
Sea lavender	Limonium sp.	L	high marsh, shrub border
Glasswort	Salicornia virginica	Sv	high marsh
Salt-marsh aster	Aster sp.	A	high marsh
Sea ox-eye	Borrichia frutescens	Bf	high marsh, shrub border
Salt-grass	Distichlis spicata	Ds	high marsh, shrub border
Salt-marsh fimbristylis	Fimbristylis spadicea	Fs	high marsh, shrub border
Seaside goldenrod	Solidago sempervirens	Ss	high marsh, shrub border
Coastal dropseed	Sporobolus virginicus	SV	high marsh
Black needlerush	Juncus roemerianus	Jr	high marsh, shrub border
American three-square	Scirpus americanus	Sa	high marsh
Salt-marsh bulrush	Scirpus robustus	Sr	high marsh
Narrow-leaved cattail	Typha angustifolia	Ta	high marsh
Sea-blite	Suaeda linearis	Sl	high marsh (shell mounds)
Switchgrass	Panicum virgatum	Pv	shrub border
Poison ivy	Rhus radicans	Rr	shrub border
High tide bush	Iva frutescens	If	shrub border
Sea myrtle	Baccharis hamilifolia	Bh	shrub border, adjacent upland
Wax myrtle	Myrica cerifera	Mc	shrub border, adjacent upland
Coastal cedar	Juniperus virginiana	Jv	adjacent upland
Slash pine	Pinus elliottii	Pe	adjacent upland
Loblolly pine	Pinus taeda	Pt	adjacent upland
Yaupon	Ilex vomitoria	Iv	adjacent upland
Live oak	Quercus virginiana	Qv	adjacent upland
Greenbriar	Smilax sp.	S	adjacent upland
Pokeweed	Phytolacca americana	Pa	adjacent upland
Broomsedge	Andropogon sp.	A	adjacent upland, shrub border
Finger grass	Chloris sp.	C	adjacent sand flat
Beach elder	Iva imbricata	Ii	adjacent sandflat
Sea oats	Uniola paniculata	Up	adjacent dune ridge
Camphorweed	Heterotheca subaxillaris	Hs	adjacent sandflat, spoil area
Dock	Rumex cf. hastatulus	Rh	adjacent sandflat, spoil area

Source: S. C. Wildlife and Marine Resources Department

TABLE 12. Results of field observations of 19 marsh locations in Little River Inlet study area.

STATION NO.	GENERAL LOCATION	DOMINANT VEGETATION	ASSOCIATED VEGETATION	APPROXIMATE ELEVATION (FT. above MLW)	COMMENTS
1	Bird Island	*Spartina alterniflora*		4.0	Monospecific stand
1a	Bird Island	*Spartina patens*	SSA, L, Bf, Sv, Ds, P, Sc, Ma, Ph	7.1	Probable old spoil mound
2	Barefoote Creek	*Spartina alterniflora*		4.6	Monospecific stand
3	Goat Island	*Spartina alterniflora*	Higher elevations - Sv Bf, L, Sp, Fs	4.3	Seaward edge of island - Sp, Sv, Ds, If, Pv, Sp, Bh, Bf, L, Ds, Jr
4	Goat Island	*Spartina alterniflora* (SSA & SSA)	Marsh edge - SSA, Ds, Sp, Bf, If, Pv, Bh, Jr	3.5	Edge of island - Pt, Mc, S and other maritime forest species
5	Goat Island	*Spartina patens*	If, Bf, L, Bh, Mc, Pv, Jr	5.5	Lower elevations - MSA, Sv, Ds, Bf, L, A
5a	Goat Island	*Spartina alterniflora*	Higher elevations - Ds, MSA, If, L, Sp, If	3.7	
6	Waties Island	*Salicornia virginica*	MSA, Ds, L, Bf	5.3	Higher elevations (spoil mound) - Sp, If, Bf, Ds, SSA, A, Pv, Fs, Cs, Sp, v.
7	Waties Island	*Spartina patens* (higher levels) Mixed community (lower levels)	Bf, If, Ds, Sv, A, L, Bf, Ds, Sv, SSA, A, L	5.5	*Spartina patens* replaced by *Spartina alterniflora* at lower elevations
8	Waties Island	*Spartina patens*	Fs, Ds, Bf, L, Mc, Sr, Iv	5.8	
9	Mink Island	*Spartina alterniflora*		5.2	Monospecific stand
10	Mink Island	Mixed community - Mc, Jv, Iv, Bh, If	Typical high marsh species	7.4	Former open marsh disposal area
11	Milliken Cove	*Spartina alterniflora*	Sr, If, Bf, Sp and other high marsh species	4.5	
12	Calkins Neck ATM	*Spartina alterniflora*	Ta, Bf, If, Ph and other high marsh species	5.0	
13	Little River Neck Little River	*Spartina alterniflora*	Sc, Sr, Ta, Jr, Sv, L, Sp, If, Bf, Bh, Sl	4.5	Edge of mainland - Mc, Bh, Pt, Jv, Qv, Iv; *Scirpus americanus* abundant along marsh-upland border
14	The Battery Island	*Spartina alterniflora*		3.4	Monospecific stand
15	Durn Island Creek	*Spartina alterniflora*		4.4	Monospecific stand
16	Durn Island Creek	*Spartina alterniflora*		4.2	Monospecific stand
17	Durn Island Creek	*Spartina alterniflora*		3.2	Monospecific stand

Source: S. C. Wildlife and Marine Resources Department

TABLE 13

COMMERCIAL FISHERY LANDINGS, [illegible]

TOTAL FINFISH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	194,996	1,998,97[illegible]	371,322	[illegible]	[illegible]	[illegible],286,428	400,22[illegible]	[illegible],741,000	[illegible]	[illegible],783	280,839	4,812,[illegible]	156,0[illegible]
SHELLFISH																				
Crabs, blue, hard	[illegible]	[illegible]			22,440	3,970	-	-	92,499	12,701	10,000	1,500	[illegible]	931	30,400	2,9[illegible]	2,675	253	[illegible]	3,210
Shrimp, saltwater (heads on)	1,226,[illegible]	1,4[illegible]	684,[illegible]	[illegible]	888,821	33,906	723,500	412,192	1,193,533	1,352,225	602,800	783,774	765,296	475,466	838,300	447,4[illegible]	[illegible],220	496,426	1,017,6[illegible]	545,932
Clams, hard (meats)	11,14[illegible]	13,33[illegible]			9,681	8,951	22,700	30,553	14,769	7,347	34,300	29,951	16,730	7,360	49,000	30,91[illegible]	[illegible],210	118,5[illegible]	77,3[illegible]	46,677
Oysters (meats)	[illegible]	[illegible]			77,106	41,448	113,800	86,026	56,137	29,662	116,000	99,341	38,675	19,180	130,800	89,8[illegible]	[illegible],299	19,420	81,[illegible]	[illegible],937
Octopus					-	-	-	-	1,000	150	5,500	873	-	-	1,700	266		-	200	26
Squid	[illegible]	[illegible]		-	712	221	-	-	1,347	202	-	-	-	-	400	[illegible]		-	600	86
TOTAL SHELLFISH	1,[illegible],150	1,[illegible],846	[illegible]96,60[illegible]	[illegible]	998,760	588,496	860,000	528,771	1,359,285	1,402,287	968,600	905,419	808,206	502,937	1,050,600	570,57[illegible]	1,[illegible],404	634,634	1,204,800	650,818
GRAND TOTAL	[illegible]28,002	1,941,000	4,651,406	1,193,[illegible]	2,405,608	799,234	4,650,500	923,767	1,358,261	1,773,609	4,641,600	1,203,880	4,094,634	903,164	16,791,600	979,53[illegible]	[illegible],014,187	915,473	5,017,100	806,863

1 Includes Georgetown, Horry and Marion Counties.
[illegible]From [illegible] Landings, Annual Summaries, U. S. Dept. of Commerce in cooperation with the S. C. Wildlife and Marine Resources Department and Brunswick, N. C., Landings, U. S. Dept. of Commerce letter report)

Table 14

CONSIDERED LEVELS OF IMPROVEMENT
FOR NAVIGATION FACILITIES

ITEM	Plans of Improvement			
	A	B	C[1/]	D
PERTINENT DATA				
Entrance channel depth	8	10	12	14
Inner channel depth	6	8	10	12
Initial dredging (C.Y.)	950,000	1,120,000	1,290,000	1,510,000
Deposition basin				
Upcoast	450,000	450,000	450,000	450,000
Downcoast	230,000	230,000	230,000	230,000
Entrance channel	220,000	330,000	440,000	580,000
Inner channel	50,000	110,000	170,000	250,000
Annual maintenance dredging (C.Y.)	303,000	306,000	309,000	313,000
North Jetty length (ft)	3,790	3,790	3,790	3,790
South Jetty length (ft)	3,570	3,570	3,570	3,570
PROJECT FIRST COSTS	$11,667,000	$11,810,000	$11,959,000	$12,222,000
AVERAGE ANNUAL COSTS	$1,330,200	$1,343,800	$1,358,700	$1,382,300
Maintenance costs	551,000	555,000	560,000	566,000
Interest & amortization	779,200	788,000	798,700	816,300
BENEFITS				
Party boating	$258,300	$489,200	$534,400	$534,400
Charter boating	100,100	231,800	236,400	236,400
Recreational boating	297,200	321,000	351,600	351,600
Commercial fishing	321,300	423,700	485,300	492,500
Elimination of vessel damage	3,400	4,200	5,600	5,700
Harbor of refuge	18,400	18,400	18,400	18,400
Reduction in vessel operation costs	3,200	4,200	5,100	5,300
TOTAL ANNUAL BENEFITS (Navigation Facilities)	$1,001,900	$1,492,500	$1,636,800	$1,644,300
Excess of benefits over costs	0	148,700	278,100	262,000
Benefit-to-cost ratios	0.8	1.1	1.2	1.2

1/ Recommended plan of improvement

APPENDIX A

ECONOMIC DATA, EXTRACTED FROM U. S. ARMY, CORPS OF ENGINEERS GENERAL DESIGN MEMORANDUM, LITTLE RIVER INLET, SOUTH CAROLINA. COMPLETE DOCUMENT IS AVAILABLE AT U. S. ARMY ENGINEER DISTRICT, CHARLESTON, SOUTH CAROLINA

SUMMARY OF ESTIMATED ANNUAL BENEFITS

Item	
NAVIGATION FACILITIES	
Party boating	$ 534,400
Charter boating	236,400
Recreational boating	351,600
Commercial fishing	485,300
Elimination of vessel damage	5,600
Harbor of refuge	18,400
Reduction in vessel operating costs	5,100
TOTAL ANNUAL BENEFITS (Navigation Project)	$1,636,800
RECREATION FISHING WALKWAY	112,000
REDEVELOPMENT	74,600
TOTAL PROJECT ANNUAL BENEFITS	$1,823,400

APPORTIONMENT OF FIRST COSTS

NAVIGATION FACILITIES	
Federal	$9,999,700
Non-Federal	1,959,300
TOTAL	$11,959,000
RECREATION FISHING WALKWAY	
Federal	$ 510,000
Non-Federal	510,000
TOTAL	$ 1,020,000
TOTAL PROJECT FIRST COST	$12,979,000

APPORTIONMENT OF AVERAGE ANNUAL COSTS

NAVIGATION FACILITIES	
Federal	$1,227,800
Non-Federal	130,900
TOTAL	$1,358,700
RECREATION FISHING WALKWAY	
Federal	$ 32,950
Non-Federal	58,950
TOTAL	$ 91,900

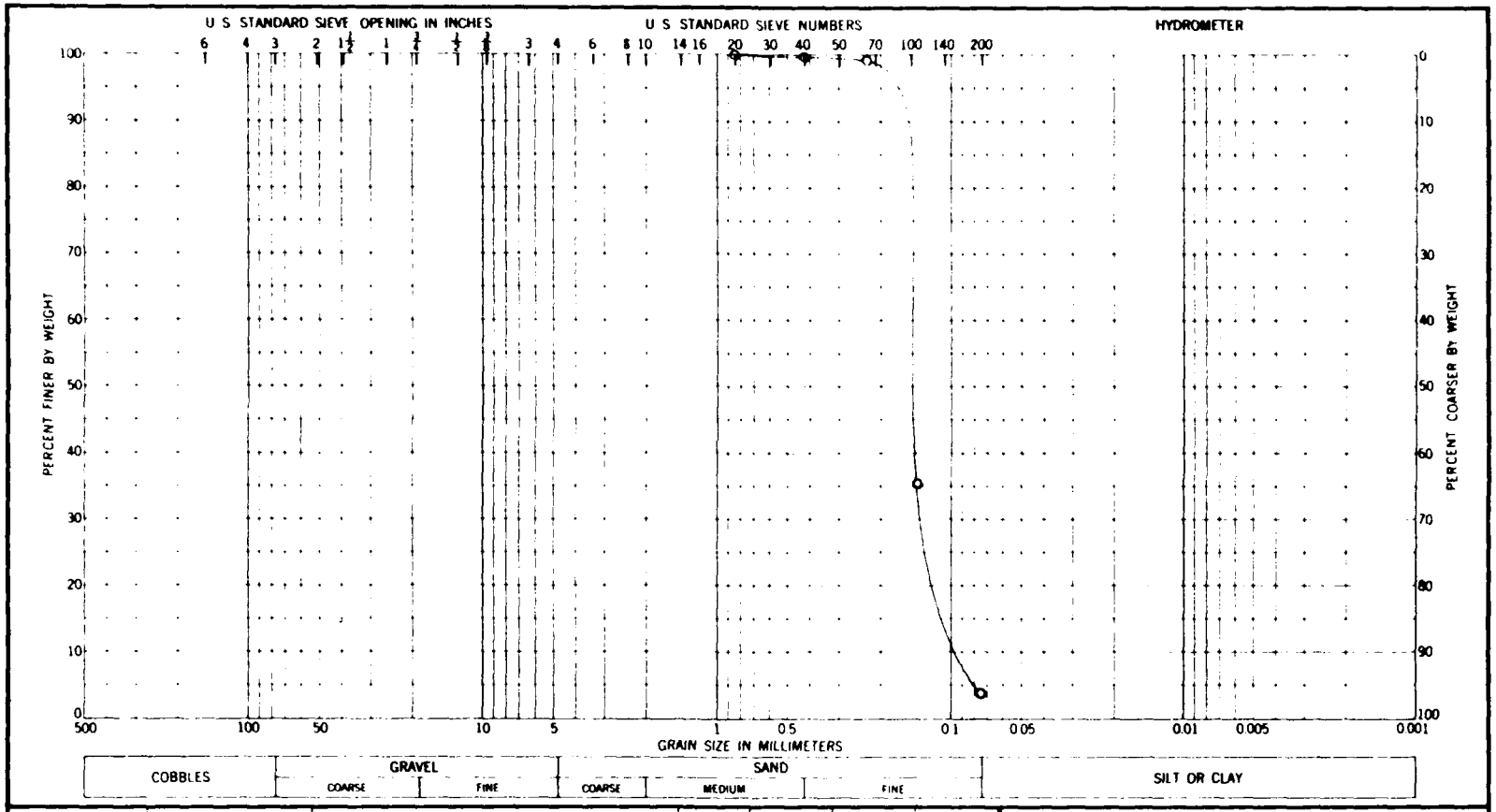
Benefit-Cost Ratio (Navigation Facilities)	1.2:1
Benefit-Cost Ratio (Recreation Fishing Walkway)	1.2:1

APPENDIX B

GRAIN SIZE ANALYSIS

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30061

WORK ORDER NO 9824
Req. No SACEC-76-45



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
76002	--	Gray poorly graded sand(SP)	-	-	-	-

GRADATION CURVES

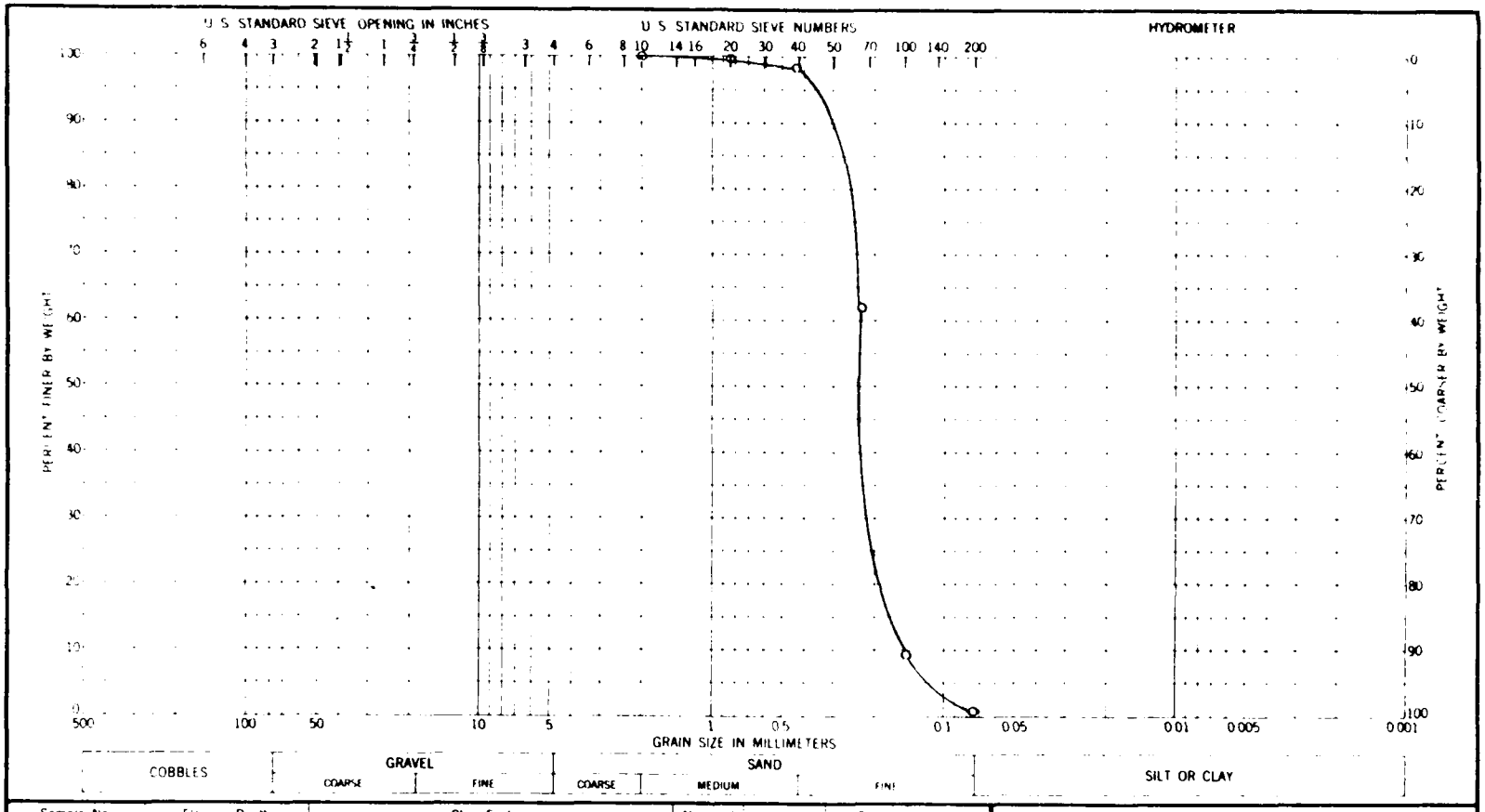
Project: Little River, South Carolina
Lab. No. 3S-607 *
Area: --
Boring No. --- Sample No. 76002 LRI-2
Date: 4 June 1976

ENG FORM 1 MAY 63 2087

* Chemical Analysis on SAD Form 158-R.

DEPARTMENT OF THE ARMY SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS 510 SOUTH COBB DRIVE MARIETTA, GA 30061

WORK ORDER NO 9824
Req. No. SACEC-76-45



Sample No	Elev. or Depth	Classification	Nat w %	LL	PL	PI
02-76004, LRI-1	--	Light gray poorly graded sand (SP)	-	-	-	-

GRADATION CURVES

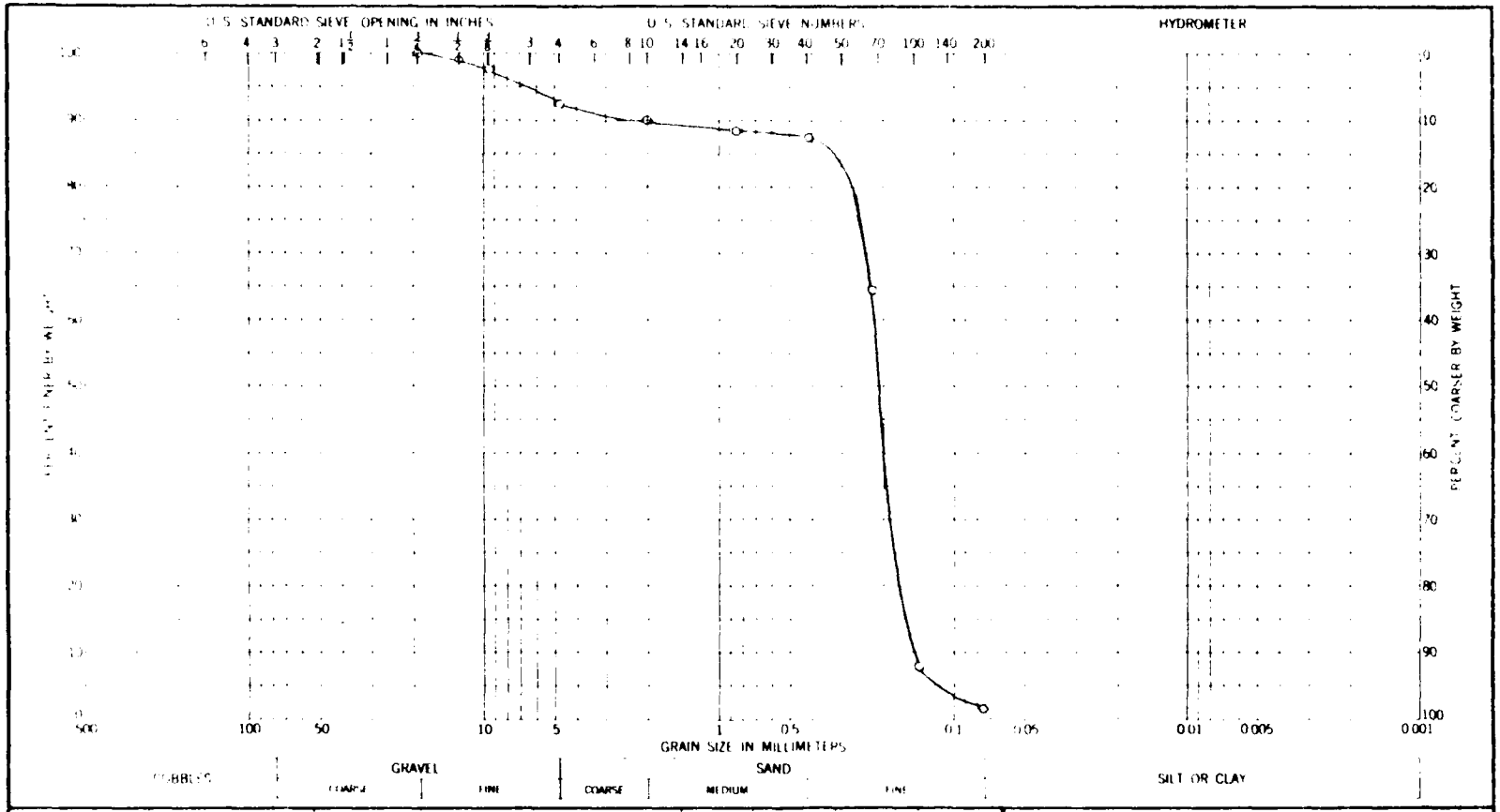
Project: Little River, South Carolina
Lab. No. 3S-608 *
Area: --
Boring No: --Sample No. 02-76004,LRI-1
Date: 4 June 1976

ENG FORM 2087

* Chemical Analysis on SAD Form 158-R.

DEPARTMENT OF THE ARMY [illegible] DIVISION LABORATORY
CORPS OF ENGINEERS [illegible] SOUTH PEACHTREE DRIVE [illegible] GA 30084

WORK ORDER NO 9824
REQ. NO SACEC-76-45



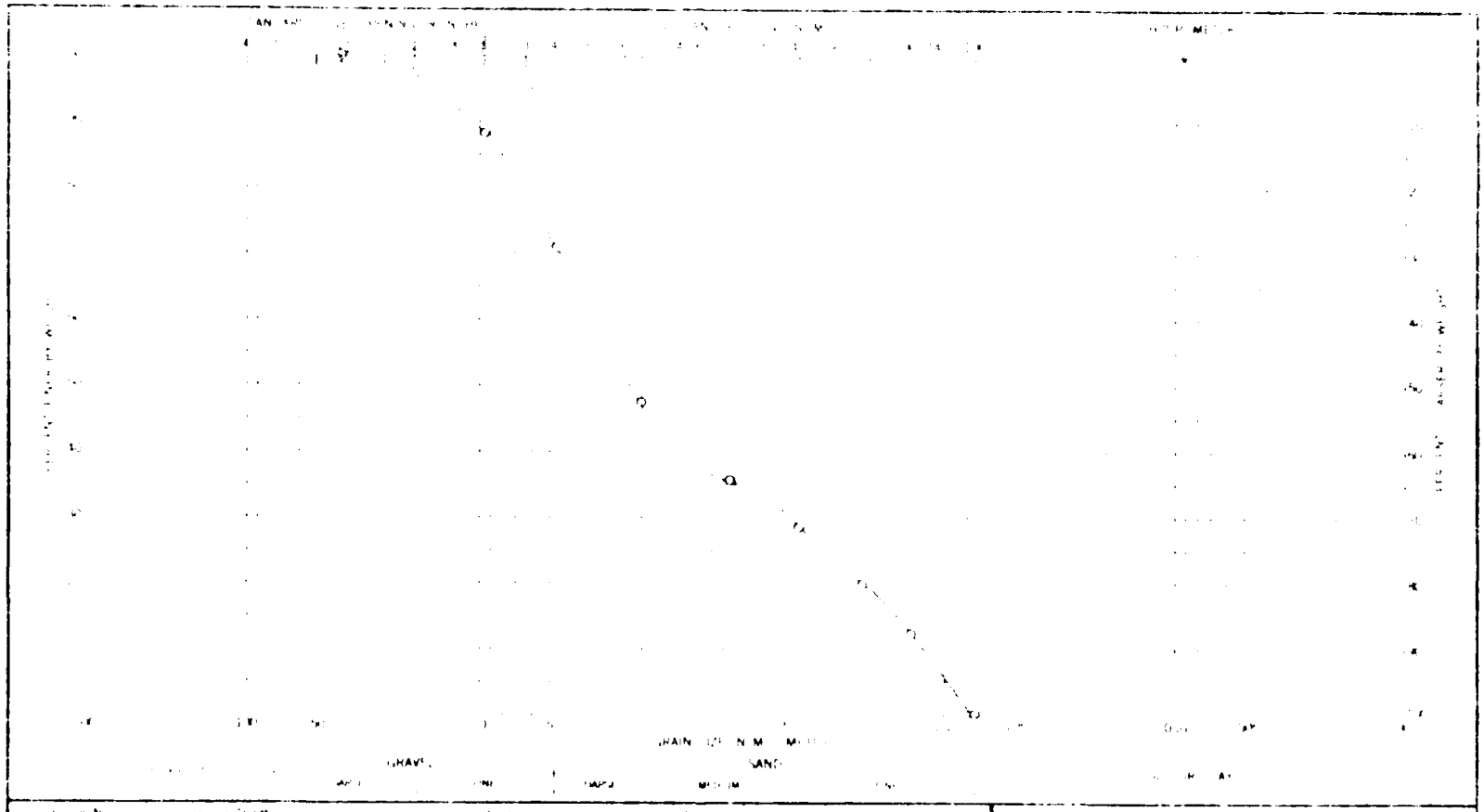
Sample No.	Elev. or Depth	Classification	Nat. w %	LL	PL	PI
02-76006, LR1-3	-	Gray poorly graded sand w/trace gravel size shell(SP)	-	-	-	-

GRADATION CURVES

Project: Little River, S. C.
Lab. No. 35-609
Area: --
Boring No.: -- Sample No. 02-76006,LR1-3
Date: 4 June 1976

ENG [illegible] 2087

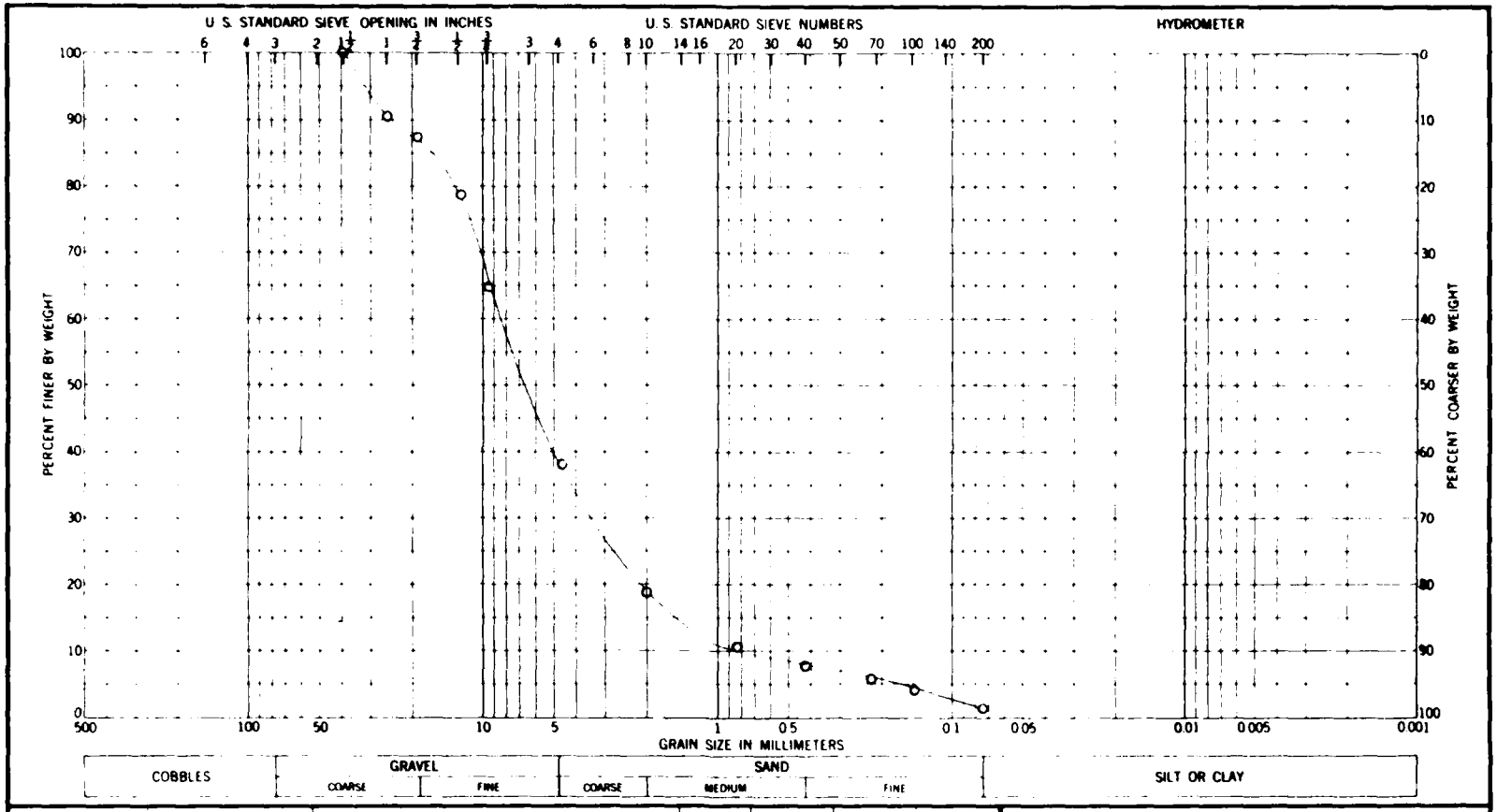
Chemical Analysis on DD Form 158-R.



GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE MARIETTA, GA. 30061

WORK ORDER NO 9.24
Req. No SACLC-75-45



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
02-76010, LRI-7	--	Gray poorly graded gravel size shell fragments w/trace sand	-	-	-	-

GRADATION CURVES

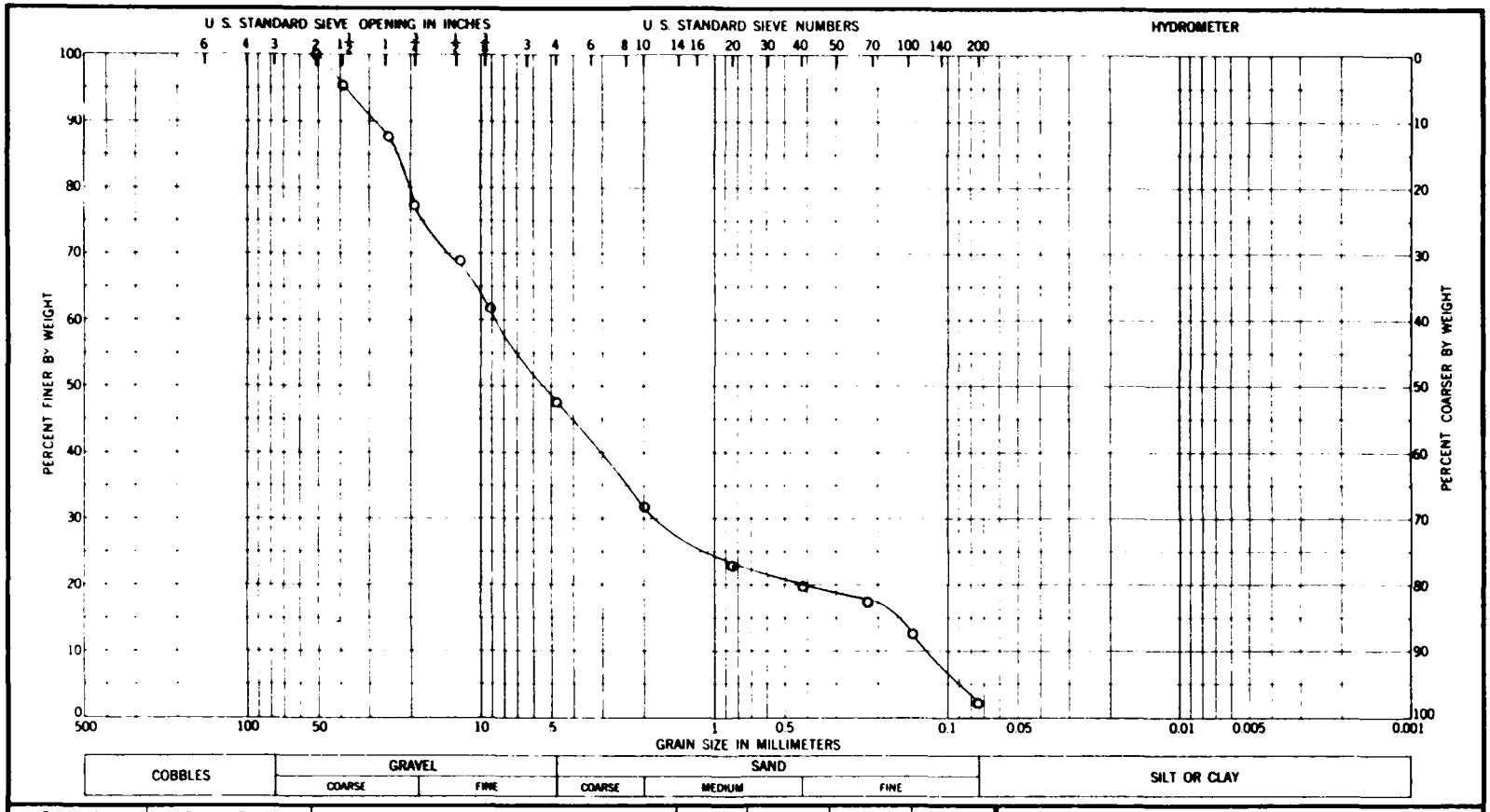
Project Little River, S.C.
Lab. No. 3S-611 *
Area --
Boring No -- Sample No. 02-76010, LRI-7
Date 4 June 1976

ENG FORM 2087

* Chemical Analysis on SAD Form 158-R.

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE MARIETTA, GA. 30061

WORK ORDER NO 9824
Req. No. SACEC-76-45



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
02-76012, LRI-9	--	Gray well graded gravel size shell fragments w/trace sand	-	-	-	-

GRADATION CURVES

Project: Little River, S. C.
Lab. No. 3S-612 *
Area: --
Boring No.: --Sample No. 02-76012,LRI-9
Date: 4 June 1976

ENG FORM 1 MAY 63 2087

* Chemical Analysis on SAD Form 158-R.

APPENDIX C

Letters of Comment

TABLE OF CONTENTS

15 DEC 1976

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

1421 PEACHTREE ST. N.E.
ATLANTA GEORGIA 30309

October 13, 1976

Colonel Harry S. Wilson, Jr., USA
District Engineer
Corps of Engineers, Charleston District
P.O. Box 919
Charleston, S.C. 29402

Dear Colonel Wilson:

The Environmental Protection Agency has reviewed the Draft Environmental Impact Statement for the Little River Inlet Navigation [illegible] Brunswick County, North Carolina and Horry County, South Carolina and we have no objections to the proposed project. [illegible] adequately sets forth the environmental impact of [illegible] project as well as reasonable alternatives.

Pursuant to our review, we have categorized the project LO (Lack of Objections) and the Impact Statement 1 (Adequate). We will appreciate receiving one copy of the Final Statement when available, and if we may be of further assistance, please let us know.

Sincerely yours,

John E. Hagan, III
Chief, EIS Branch

E-2

United States Department of the Interior

OFFICE OF THE SECRETARY

Southeast Region / 148 Cain St., N.E. / Atlanta, Ga. 30303

ER-76/991

DEC 6 1976

Colonel Harry S. Wilson, Jr.
District Engineer
U.S. Army Corps of Engineers
P. O. Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

This is in response to your October 12, 1976, letter. We have reviewed the draft environmental statement and design memorandum No. 1 for Little River Inlet, navigation project in Brunswick County, North Carolina and Horry County, South Carolina for effects on parks, recreation, cultural resources, mineral resources, geology, hydrology, and fish and wildlife resources.

General Comments

(1) The statement does not adequately identify cultural resources nor does it adequately assess the project's potential impacts on these resources. Design memorandum no. 1 and the revised draft impact statement contain no information that assures cultural resources which exist in the project's immediate area have received [illegible] consideration in the planning process. The information is presented that [illegible] surveys and contacts with the proposed project have determined the presence of no cultural resources on Holden Beach or Holden Beach Island. However, the environmental impact statement fails to indicate steps taken by the Corps of Engineers to fulfill its responsibilities to identify and protect cultural resources which may or will be affected by implementation of the project. Consideration of cultural resources, as required by 33 CFR, part 305, should provide adequate data for presentation in the final statement.

Minor quantities of sand and gravel are produced in Brunswick and Horry Counties, with a small amount of clay also being produced in Horry County. No records show evidence of mineral production or significant resources in the immediate vicinity of the proposed project site. Implementation of this proposal should result in no significantly adverse impact on the mineral resources of the area.

Specific Comments

(4) Page 3, last paragraph

While [illegible] importance of the marsh, this paragraph fails to [illegible] point out that the marsh serves as a spawning and nursery [illegible] important sport and commercial finfish. A list of some of the important species of the project area include mullet, striped bass, flounder, shad, channel bass, sea trout, spotted Atlantic croaker, and [illegible] mackerel.

(5) Page 3, last paragraph, p.70

This section should be expanded to provide information on the extent and [illegible] archaeological resources in the area affected. If [illegible] salvage is not sufficient to assure adequate examination of the [illegible] occurred, it is the responsibility of the Corps of Engineers to undertake a survey sufficient to identify all resources. All resources must be evaluated for significance.

(6) [illegible], p. 3-71

[illegible] should include more specific information on the magnitude [illegible] would be adequately assess increases of turbidities that may result from erosion of dredge spoil disposal areas on beaches.

(5) The statement should indicate the aquifer to be tapped by the proposed [illegible] and should state whether any appreciable [illegible] will result.

[illegible], p. 3-1

(6) It is stated that the construction of the southside dike may require the [illegible] of three acres of water in the marsh and one acre of high [illegible] at the mouth end of Cotton Island. The Fish and Wildlife Service [illegible] that it is not that there is a less biologically damaging [illegible] which is not discussed. Relocation of the south sand dike [illegible] would fill more upper high marsh and wooded upland and [illegible].

Page 3, paragraph 4.03

(7) This section should be expanded to discuss impacts on cultural resources which are not on the National Register as well as those which may be eligible for nomination to the Register.

The statement "Construction would be coordinated with the State Historic Preservation Officer and State Archaeologist to minimize potential damage to sites of historical or archaeological interest in the area" is interpreted to mean that cultural resources will only be considered after planning has been completed and construction initiated. This action would circumvent Federal agency responsibilities in identification and protection of cultural resources which must be done in the planning as well as in construction stages. We recommend this sentence be omitted from the final statement and replaced with an adequate discussion of potential impacts recognized as a result of adequate resource identification and evaluation. Steps planned to mitigate potential impacts should be discussed.

(8) Page 39, section 8.0

This section should be expanded to include discussion of impacts on cultural resources. Protection is a primary responsibility in Federal agency planning. Discussion should clearly indicate efforts made to protect significant resources. Alteration or salvage of significant resources are clearly adverse impacts and should be undertaken only after a determination is made, in consultation with the State Historic Preservation Officer and the Advisory Council on Historic Preservation, that there is no other alternative.

(9) Page 42, section 8.0

This section should be expanded to include cultural resources.

Thank you for the opportunity to review and comment on the draft statement and design memorandum.

Sincerely yours,

June Whelan

(Miss) June Whelan
Special Assistant to the Secretary
Southeast Region

C-2

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230

December 6, 1976

Col. Harry S. Wilson, Jr.
Corps of Engineers
Department of the Army
P. O. Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

This is in reference to your revised draft environmental impact statement entitled, "Little River Inlet, Navigation Project, Brunswick County, North Carolina and Horry County, South Carolina". The enclosed comments from the National Oceanic and Atmospheric Administration are forwarded for your consideration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving eight copies of the final statement.

Sincerely,

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclosures Memo from National Ocean Survey

C-3

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md 20852

C52/JLR

NOV 30 1976 DEC 2 1976

TO: William Aron
Director
Office of Ecology and Environmental Conservation

FROM: Gordon Lill
Deputy Director
National Ocean Survey

SUBJECT: DEIS #7610.33 - Little River Inlet Navigation Project, N.C.

The subject statement and General Design Memorandum (GDM) have been reviewed within the areas of NOS responsibility and expertise, and in terms of the impact of the proposed action on NOS activities and projects.

The following comments are offered for your consideration.

In compliance with a Cooperative Agreement between the U.S. Army Corps of Engineers (CE), Charleston District, and the National Ocean Survey (NOS), NOS installed ADR (Analog to Digital) tide gages at 13 CE installations throughout the Little River system in an effort to obtain tidal datums in the area.

① In paragraph 2.18 of the DEIS, CE states that at a point one mile above the mouth of the Little River Inlet (NOS assumes that CE means 1.0 mile inland) the mean tide range is 5.0 feet and the spring range is 5.9 feet. The NOS measurements for this general area indicate a mean tide range of 4.5 feet to 4.7 feet and a spring range of 5.2 feet to 5.4 feet depending upon the exact location of interest. Final datums computed from NOS measurements taken at the town of Little River indicate a mean tide range of 4.4 feet and a spring range of 5.0 feet.

② NOS has not completed a rigorous study and analysis of the circulation in the Little River system. The statements made in paragraph 4.02 in the DEIS and paragraph 51 of the GDM could be investigated further. NOS agrees that CE's expectation of an initial 10 percent decrease in the tidal prism in the Little River Inlet is probably a fair estimate.

CE then predicts that this 10 percent reduction in the tidal prism will decrease after channel stabilization to a mere 0.1 foot shift downward in both the mean high water and the mean low water datums. This is interpreted to mean CE expects no change in the tidal prism after channel stabilization. Whether this prediction is based on CE's hydraulic model of the inlet, or if there is other supporting evidence that was not included, is unclear.

(3) NOS agrees that there will be a certain amount of scouring in the proposed outer channel due to an increased ebb flow in that area. However, the extent of deposition and subsequent change in tidal datums which will occur in the proposed inner channel due to the possible decrease in ebb flow velocities in these areas, have not been addressed.

(4) Finally, NOS inquires about the availability of results from past navigation improvement projects, similar to the one proposed, to support CE's prediction of no significant change in tidal heights occurring as a result of project construction in the Little River system.

C-4

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
1720 Peachtree Road, N. W.
Atlanta, Georgia 30309

November 26, 1976
8400

Colonel Harry S. Wilson, Jr.
Department of the Army
Charleston District
Corps of Engineers
P.O. Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

The United States Forest Service, State and Private Forestry review of the revised draft environmental impact statement covering the Little River Inlet Navigation Project in Brunswick County, North Carolina, and Horry County, South Carolina, reveals no significant project impacts on forest lands or resources in the area. Consequently, we have no comments on the proposal.

Thank you for the opportunity to review and comment on the revised draft EIS.

Sincerely,

ROBERT K. DODSON
Area Environmental Coordinator

Copy: State Forester: North Carolina
South Carolina

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

241 Stoneridge Drive, Columbia, South Carolina 29210

October 27, 1976

Colonel Harry S. Wilson, Jr.
District Engineer
Charleston District, Corps of Engineers
Department of the Army
P. O. Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

This is in response to your recent request for comments on the draft environmental impact statement and draft General Design Memorandum for the Little River Inlet Navigation Project, South Carolina.

We did not find a vegetative plan relative to the construction involved in this project. It appears to us that much of the proposed sand dike should be vegetated. In certain areas the dike appears to be primarily in order part of the frontal dune system. Adapted vegetation is a critical element in dune stabilization.

It is recommended that a study be made of the proposed sand dike as well as all other areas of planned disturbance and a supporting vegetative plan prepared.

Sincerely,

Norman E. Shuler
Assistant State Conservationist

C-5

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

P. O. Box 27307, Raleigh, North Carolina 27611
Telephone 919 755-4210

October 29, 1976

Colonel Harry S. Wilson, Jr.
District Engineer, Corps of Engineers
Department of the Army
P. O. Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

We received three copies of the revised draft environmental impact statement for the Little River Inlet Navigation Project, South Carolina. The project is located almost entirely within South Carolina with the exception of the sand dike on Bird Island across the state line in North Carolina.

The cover letter transmitting copies of the statement did not identify our North Carolina organization. We assume the copies are primarily for information. George F. Huey, South Carolina State Conservationist, Soil Conservation Service, has reviewed the report as it pertains to North Carolina. We have no comment on the statement.

Sincerely,

Jesse I. Hicks
State Conservationist

cc: Council on Environmental Quality, 722 Jackson Place, N.W., Washington, D. C. (5 copies)
USDA Coordinator of Environmental Activities, Office of the Secretary, U.S. Department of Agriculture, Washington, D.C. 20250
R. M. Davis, Administrator, SCS, Washington, D.C.
S. G. Lane, Director, State Soil & Water Conservation Commission, Raleigh, N.C.
G. E. Huey
J. V. Martin

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGION IV
ATLANTA, GEORGIA 30323

November 23, 1976

OFFICE OF THE REGIONAL DIRECTOR

HEW-705-10-76

Harry S. Wilson, Jr.
Colonel, Corps of Engineers
District Engineer
Department of the Army
Charleston District Corps of Engineers
P.O. Box 919
Charleston, South Carolina 29402

Subject: Little River Inlet
Navigation Project
Brunswick County, North Carolina
and Horry County, South Carolina

Dear Mr. Wilson:

We have reviewed the subject Draft Environmental Impact Statement (Revised). Based upon the data contained in the draft, it is our opinion that the proposed action will have only a minor impact upon the human environment within the scope of this Department's review. The impact statement has been adequately addressed for our comments.

Sincerely yours,

Philip P. Sayre

Philip P. Sayre
Regional Environmental Officer
DHEW - Region IV

C-6

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
REGION IV
Peachtree Plaza
1371 Peachtree Street, N.E.
Atlanta, Georgia 30309

AREA OFFICE
415 NORTH EDGEWORTH STREET
GREENSBORO, NORTH CAROLINA 27401

January 7, 1977

IN REPLY REFER TO
4.40S

U. S. Army Engineer District
Corps of Engineers
Charleston, South Carolina

Dear Sirs:

Subject: Draft Environmental Impact Statement (Revised)
Little River Inlett
Navigation Project
Brunswick County, N. C.
Horry County, S. C.

Thank you for the opportunity of reviewing the proposal. We have no substantive comments to make at this time.

Sincerely,

for P. B. Barnwell
Area Director

cc: Regional Environmental Standards Officer

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
2001 Assembly Street, Suite 203
Columbia, South Carolina 29201

October 22, 1976

Colonel Harry S. Wilson, Jr.
Charleston District, Corps of Engineers
Post Office Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

Reference is made to your letter dated October 12, 1976 transmitting the draft environmental impact statement for the Little River Inlet Navigation Project, South Carolina.

We have reviewed the statement and find that the proposal does not conflict with present or planned highway facilities within FHWA mission areas.

Sincerely yours,

W. H. Rice, Jr.

W. H. Rice, Jr.
District Engineer

For B. G. Cloyd
Division Administrator

C-7

North Carolina Department of Administration

OFFICE OF INTERGOVERNMENTAL RELATIONS
EDWIN DECKARD DIRECTOR

JAMES E. HOLSHOUSER, JR. GOVERNOR • BRUCE A. ITNTZ, SECRETARY

November 29, 1976

Colonel Harry S. Wilson, Jr.
Charleston District, Corps of Engineers
Department of the Army
Post Office Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

Re: SCH File #158-76: Draft (Revised) EIS-Little River Inlet Navigation Project; Brunswick County, NC & Horry County, South Carolina

SCH File #159-76: General Design Memorandum - Little River Inlet; NC & SC

The State Clearinghouse has received and reviewed the above referenced projects. As a result of this review, the State Clearinghouse has received comments from the Office of Marine Affairs and Department of Human Resources. Comments from both Departments are attached.

We appreciate the opportunity comment on the above referenced projects. If we may be of further assistance in this matter, please let us know.

Sincerely,

Chrys Baggett

Chrys Baggett (Mrs)
Clearinghouse Supervisor

CB:mw
cc: Region "O"

Attachments

[illegible] Environmental Impact
[illegible] Shallotte River Inlet Navigation No. 1
Little River Inlet Navigation Project
Brunswick County, North Carolina
and Horry County, South Carolina;
SCH File Numbers 158-76 and 159-76

The Office of Marine Affairs is particularly interested in the Little River Inlet Navigation Project because similar projects are in various stages of the planning process for a number of North Carolina's inlets. The high expense of these projects together with their potential adverse effect on the water-sediment transport system of the coastal environment suggest that such projects should be pursued selectively and with caution.

(1) To assist in putting the Little River Project in perspective, it would be helpful if the geology section of the Draft EIS and Design Memorandum included a discussion on the functions and values of natural inlets and the ongoing geological processes in inlet dynamics. The cycle of inlet formation, migration, and closure plays an important part in widening an island and insuring the continued integrity of the barrier island system. What affect does jetties and dredging have on this system?

(2) Similarly a brief discussion of how the Corps selects and prioritizes inlets for improvement in a given region as well as how the Little River Project relates to the overall navigational needs for the region would also be appropriate. In this light the status and potential for future navigational projects for North Carolina's inlets in the vicinity of the Little River project - such as Mad Inlet, Lockwoods Inlet, and Shallotte Inlet should be presented.

(3) The program designed to monitor the project effects (Design Memorandum, pages 81-86) is particularly desirable and could provide significant information to address the questions raised above on jetties and dredging affect natural inlet dynamics. If possible it might be advantageous to expand the monitoring program to include some indicators of the project's effects on biological as well as physical systems of the area. The monitoring program should also be discussed in the Draft EIS. (4) It would also be more clear if the annual operating costs for the monitoring program as well as other annual costs such as jetty and sand dike maintenance (Design Memorandum Para. 142 & 143) were explicitly broken out in the cost/benefit analysis of the project (See Table 14, p. 87 of the Draft EIS, and Design Memorandum, pp. 89-94, and Table 44 and 45 of Appendix E).

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North Carolina State Clearinghouse Comments

SCH # 158-76

Date: November 29, 1976

(1) The Department of Human Resources submits the following comment: We have no objections to this project construction is in accordance with submitted plans.

SCH # 159-76

Date: November 29, 1976

(2) The Department of Human Resources submits the following comment: We have no objections to this project provided plans are included for the control of mosquitoes that are created in those areas in which the spoil is dyked. The dyked spoil islands have created severe mosquito problems in many areas of the state and appropriate plans must be devised for the control of mosquitoes in these specific areas.

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North Carolina Department of Administration

OFFICE OF INTERGOVERNMENTAL RELATIONS

JAMES E. HOLSHOUSER, JR., GOVERNOR ○ BRUCE A. LENTZ, SECRETARY

January 4, 1977

MEMORANDUM

TO: Colonel Harry S. Wilson, Jr.

FROM: Chrys Baggett (Mrs) CB

SUBJECT: Little River Inlet Navigation Project, SCH #158-76 and SCH #159-76, General Design Memorandum

Attached are additional comments which were submitted following our clearance letter on your

_____ Notification To Clearinghouse Of Intent To Apply For Assistance

_____ Application for funding

XXX Environmental Impact Statement

_____ Environmental Review

If you have questions regarding these comments please contact me at (919) 829-2594.

CB/mw
cc: Region "O"

North Carolina Department of Natural & Economic Resources

January 5, 1977

To: Chryo Bassett

From: Ozzie Gray

Subject: Little River Inlet Navigation Project, SCH #156-76 and General Design Memorandum, SCH # 199-76

The Department of Natural & Economic Resources has reviewed the subject documents. As the agency charged with protection of [illegible] and wildlife, assuring that water and air quality is maintained at the highest standards possible, and [illegible] planning and development programs, we found that the DEIS has adequately addressed subjects of interest to them. Therefore, [illegible] at this time to offer.

C-10

South Carolina Wildlife & Marine Resources Department

James A. Timmerman, Jr., Ph.D
Executive Director
Edwin B. Joseph, Ph.D
Director of
Marine Resources Center

December 8, 1976

Elmer C. Whitten, Jr.
State Clearinghouse
Division of Administration
1205 Pendleton Street
Columbia, South Carolina 29201

Re: 08-2002-7; Little River Inlet Navigation Project

Dear Mr. Whitten:

The attached letter from Charles Bearden to Duncan Newkirk represents the Department's preliminary comments on this project. Any additional comments will be forwarded to your office next week.

Thank you for your help on this project. We will advise you of the final comments on this project by Friday, December 17.

Sincerely,

James A. Timmerman, Jr.

James A. Timmerman, Jr.
Executive Director

JATjr:lsb
enclosure
cc: John Carothers, Corps of Engineers

P. O. Box 12559 ◻ Charleston, South Carolina 29412 ◻ Telephone (803) 795-6350

South Carolina
Wildlife & Marine
Resources Department

James A. [illegible], Jr., Ph.D.
Executive Director
[illegible], Ph.D.
Director
Marine Resources Center

November 8, 1976

Mr. Duncan Newkirk
[illegible] Trust Bldg.
Columbia, South Carolina

Dear Duncan:

We have completed our review of the revised draft environmental impact statement for the U. S. Army Corps of Engineers' Little River Inlet Navigation Project and provide the following comments.

Generally, the revised draft statement appears to adequately describe the proposed action of the project and its impact on the estuarine environment. According to the statement, the project will provide a stabilized channel from the 12 foot contour in the ocean to the Atlantic Intracoastal Waterway of sufficient depth and width to accommodate commercial and recreational vessels. Proposed work consists of construction of two jetties (one updrift and the other downdrift), with low weir sections, a dredged sedimentation basins, entrance channels and inner channel. Sand for the jetties would be obtained from offshore borrow areas. Shoaling will dredged from the channels and deposited in the sedimentation basins annually. Construction of the north sand dike (Waites Island) may require [illegible] acre of upland marsh and 1 acre of high marsh. Nearly [illegible] cubic yards of material will be excavated from various reaches of the channel. Most of this material will be used for sand dike construction and for beach nourishment. Maintenance dredging would be required every two or three years in the inner channel and sedimentation basin. Approximately 300,000 cubic yards of material would be removed from the sedimentation basins annually and deposited on adjacent beaches, as well as [illegible] cubic yards of material annually removed from the inner channel.

The following specific comments refer to various sections of the draft environmental statement:

(1) (1) P. 2, Para. 1.06. Sand dikes. The report indicates that upon completion the sand dikes will be planted with sea oats or other tolerant plants to aid in erosion controls. A list of suitable plants would be desirable.

(2) (2) P. 17, Para 2.34. Maritime shrub thicket. Two mammals, raccoon and deer, should be included in the list of animals that may be present in shrub thickets.

(3) (3) P. 18, Para 2.40. Plankton. Amphipods and isopods should not be considered as typical members of the plankton community, since they are characteristically part of the plankton community (i.e., Gammarid amphipods) or part of the benthic community (i.e., Corophium amphipods and Cyathura isopods which are both burrowing macroinvertebrates). Also, the penaeid shrimp, such as

[illegible] (803) 795-6350

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Mr. Duncan Newkirk
November 8, 1976
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the white shrimp, brown shrimp, [illegible] our area, would serve as better examples [illegible]

(4) (4) P. 24, Para. 2.54. L. 24. "...13 tidal marsh stations..." should be revised to "...19 tidal marsh stations...".

(5) (5) P. 25, Para. 2.57. Since this para. [illegible] describe the importance of tidal [illegible] creeks also serve as nursery [illegible] fishes and invertebrates, [illegible] areas.

(6) (6) P. 24-25. Tidal Marsh. In an effort to [illegible] the nine biotic communities a list of [illegible] community should also be included in [illegible] for the other communities [illegible] salt marsh snail, [illegible] fiddler, red-jointed [illegible] Teal's work [illegible] ly appropriate [illegible] which may be applicable [illegible]

(7) (7) P. 27, Para. 2.62. [illegible] in the Little River Inlet [illegible] such an marsh edges, [illegible] to the other [illegible] 10).

(8) (8) P. 36, Para. 4.18. Marsh. Regarding the [illegible] work on the subtidal marshes, marsh [illegible] construction of the sand dikes. Most of these [illegible] move into adjacent areas, as implied by this [illegible] ed by deposition of the sandy material. This [illegible] should be noted.

(9) (9) General comment on alignment of [illegible] opinion, the effect of the project [illegible] mitigated by slightly altering the proposed [illegible] As currently proposed, about three acres of [illegible] of high marsh will be destroyed by construction of [illegible] the proposed alignment were moved slightly southward to the [illegible] to and south of existing causeway on Waites Island, only about high marsh habitat and some wooded upland habitats would be affected, thereby eliminating high marsh from destruction. We would only recommend this alignment if it is technically feasible and will not change the effectiveness of the proposed project.

We appreciate having the opportunity to comment on this project.

Sincerely,

Charles H. Hamlin, Chief
Division of [illegible]

BOARD MEMBERS

[illegible]

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

E. KENNETH AYCOCK, M.D., M.P.H., COMMISSIONER
J. MARION SIMS BUILDING — 2600 BULL STREET
COLUMBIA, SOUTH CAROLINA 29201

October 25, 1976

Colonel [illegible] S. Wilson
[illegible] District
[illegible] Engineers
P.O. Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

[illegible] office has reviewed the Draft Environmental Impact Statement for [illegible] Little River Inlet project. We do not anticipate any significant [illegible] environmental impacts on the Little River [illegible] from this project.

[illegible] appreciate the opportunity to comment on this proposed project and [illegible] can be of any assistance, please contact us.

Sincerely,

J. Marshall Eaves
Environmental Analysis Section
Programs Development Division
Bureau of Wastewater & Stream
Quality Control

[illegible]
cc: [illegible] James G. Zack, Jr.

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South Carolina Department of Archives and History
1430 Senate Street
Columbia, S. C.

P. O. Box [illegible]
Columbia, South Carolina
803 — Tele [illegible]

November 5, 1976

Colonel Harry S. Wilson
District Engineer
Department of the Army
Charleston District, Corps of Engineers
Post Office Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

We are in receipt of the Revised Draft Environmental Impact Statement for the Little River Inlet Navigation Project, Brunswick County, North Carolina, and Horry County, South Carolina. From our review of the draft, it appears that an adequate assessment of historic and archeological values has been incorporated and appropriate provisions made (4.22) to minimize potential damage to these values.

Sincerely,

Charles E. Lee
State Historic Preservation Officer

CEL/sa

State of South Carolina

Office of the Governor

[illegible]

DIVISION OF ADMINISTRATION
[illegible]
Columbia, South Carolina 29201

[illegible], 1976

[illegible] Whitten, Jr.
[illegible]
District Engineer, Corps of Engineers
[illegible]
[illegible], South Carolina 29402

[illegible]:

[illegible] Environmental Impact Statement and Draft General Design
[illegible] for the Little River Inlet Navigation Project

[illegible] enough in this combined review copy of the referenced documents. [illegible] received comments from the Department of Archives [illegible] Department of Parks, Recreation and Tourism. Other than [illegible] comments from the Water Resources Commission, the State Clearinghouse [illegible] additional comments.

[illegible] any further assistance, please contact me.

Sincerely,

Elmer C. Whitten, Jr.

[illegible]
Clearinghouse

[illegible]

[illegible] Paper — Save Trees — Conserve Resources

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State of South Carolina
Water Resources Commission

Clair P. Guess, Jr.
Executive Director

November 24, 1976

Mr. Elmer C. Whitten, Jr.
State Clearinghouse
Division of Administration
Edgar A. Brown Building
Columbia, South Carolina 29201

Re: Revised Draft E.I.S. for the Little River Inlet Navigation Project

Dear Mr. Whitten:

The staff of the South Carolina Water Resources Commission has received the revised draft environmental impact statement for the Little River Inlet Navigation Project and the preliminary Design Memorandum No. 1 for the same project. Overall it appears that the Corps of Engineers has presented a well prepared proposal, although we wish to offer several minor comments and suggestions.

(1) Section 1.10 Recreation Facilities. The impact of the proposed navigation project by the Corps and the proposed recreation park by P&Z are totally unrelated and should be separated. The benefits for the fishing walkway should be excluded unless the Corps of Engineers plans to build the walkway exclusive of P&Z intent.

(2) Section 1.11 The recommended plan of improvement for recreation should require a separate environmental impact statement.

(3) Section 1.13 Comfort Station. Relative to the requirements of the National Flood Insurance Program, what measures will be taken during the construction of this facility?

(4) Section 1.17 Parking. It appears that 4 miles of travel by walkway will be required from the parking area to the jetty. We also recommend changing the design of the parking stalls from the proposed 90° pattern to 60° or 45° stalls. Although less efficient in terms of overall capacity, angle parking greatly improves maneuverability into the stalls, aids accessibility for camper-type trailers, and may be designed to be more aesthetically appealing.

(5) Section 1.25 The wooden decking over the weir section could be replaced by prefabricated concrete planks. Although more expensive initially, the wooden decking will require more maintenance and their strength will reduce through the deterioration process, eventually becoming a safety hazard.

...Sheriff ... Little, Jr.
...Executive Board
...ust 24, 1976
Page ... 2

(3) Sections 2.74 through 2.80 Why have updated data not been utilized?

(4) Section 2.6. Transportation. Recent contact with the S.C. Highway Department indicates that the "Grand Strand Expressway" from ... Myrtle Beach, S.C. was a conceptual design ... that has never ... to date. Route S.C. 9 ... indicated in the restriction of land access since extensive widening has taken place and additional widening will be forthcoming.

(5) Section 4.0 The Probable Impact of the Proposed Action on the Environment. This project is generally undesirable from an environmental viewpoint, however, it is not necessarily devastating. It appears that the benefits will accrue to a limited number of ... and harvest fish ... owners with only limited ... to the ... public.

The Grand Strand Water ... Sewer Commission appreciates the opportunity to comment on the proposed Little River Inlet Navigation Project and offers any assistance to the Corps of Engineers that will aid in its implementation.

Very truly yours,

Blair P. Guess, Jr.
Executive Director

BPG/jrr:sv
cc:

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CAPE FEAR COUNCIL OF GOVERNMENTS

...
...
WILMINGTON, N. C. ...

Serving Local Governments in ... North Carolina
Counties of Brunswick, Columbus,
New Hanover and Pender

November 22, 1976

Director
U. S. Army Engineer District
...
Charleston, South Carolina 29402

Dear Sir:

Re: U. S. ... Little ... Project ... Horry County, S. C. and ...

The Cape Fear Council of Governments has reviewed the above referenced project. We find this ... consistent with regional goals and objectives ... with ... federal ... or programs. (No adverse ... is anticipated.)

This letter conveys the official ... comments.

Sincerely,

Beverly ...
Executive Director

BPP/ceb
cc: Chrys Baggett, Clearinghouse Supervisor

WACCAMAW REGIONAL
PLANNING AND DEVELOPMENT COUNCIL

November 10, 1976

Colonel Harry S. Wilson, Jr.
U.S. Army Corps of Engineers
Post Office Box 919
Charleston, South Carolina 29402

Dear Colonel Wilson:

The staff of Waccamaw Regional Planning and Development Council has reviewed the draft Environmental Impact Statement for the Little River Inlet Navigation Project, South Carolina. Enclosed are general and specific comments about the regarding the content of said document; they are as follows:

1. Should all the plates contained in this report be grouped together in the back portion or should they follow pages referring to such plates?

2. Why does plate 6 lack a legend?

3. Will this project affect areawide hydrology, e.g. increased flow, and more channelization which may affect future waste loads, particularly Plant 'A' Grand Strand 201?

4. Section 1.10, p.3: Has the South Carolina Department of Parks, Recreation and Tourism committed itself on the question of purchase of Waites Island for development as a park, as well as the concomitant jetty fishing walkway? If so, has PRT budgeted operating expenses and will they operate the park?

5. Section 1.29, p.5: Does "one percent of the construction cost each year" refer to the construction cost of the jetties or the entire project? This ambiguity should be clarified by inserting the proper estimated dollar amount.

6. Sections 2.24, 2.28 and 2.52, pp.14, 15 and 24: In light of the proposed new federal regulations naming the Atlantic loggerhead sea turtle a 'threatened' species and the apparent position of concern by the South Carolina Wildlife and Marine Resources Department, will mitigation measures be necessary regarding either temporary light [illegible] permanent turnance or screening of project illumination and construction relative to the nesting of this species of sea turtle?

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Colonel Harry S. Wilson, Jr.
November 10, 1976
Page 2

Thank you for providing Waccamaw Regional Planning and Development Council with the opportunity to read and comment on the draft Environmental Impact Statement.

Respectfully,

Jim L. Corbett
Chief of Planning

JLC:pc

APPENDIX D

Reference List for Section 404 Evaluation

Reference List for Section 404 Evaluation

33 CFR 209.145

209.145 e. Factors to be considered in the evaluation of Federal projects involving the disposal of dredged materials in navigable or ocean waters.

(1) Disposal of dredged materials in navigable waters. The proposed project would involve the disposal of dredged materials in navigable waters at a specified disposal site (paragraphs 1.18, 1.22, and 4.0 of the EIS). This proposed disposal has been evaluated by the application of guidelines developed by the Administrator, EPA, in conjunction with the Secretary of the Army pursuant to section 404(b) of the Federal Water Pollution Control Act. The 404(b) evaluation is presented below in paragraphs 230.4 and 230.5.

(2) Disposal of dredged material in ocean waters. Not applicable since no aspect of this project comes under the purview of P.L. 92-532.

(3) Effects on wetlands. The only wetlands which would be impacted by disposal are beach areas above mean low water. Since these areas currently have a severe erosion problem, the overall impact of using these wetland areas for disposal is in the nature of restoration and would be beneficial.

(4) Fish and wildlife. The EIS and GDM have been coordinated with all responsible Federal and State agencies in accordance with the Fish and Wildlife Coordination Act. All reports and suggestions submitted by these agencies were considered during project formulation (Appendix C of the EIS and paragraph 50 and Exhibits 1-17 of the GDM).

(5) Historic, scenic, recreational, and conservation values. Due consideration has been given to the effect which the disposal of dredged material may have on the enhancement, preservation, or development of such areas. It has been determined that the project offers no potential for adversely affecting: (1) any properties on the National Register of Historic Places; (2) endangered species; (3) rivers named in Section 3 of the Wild and Scenic Rivers Act; and (4) any other areas named in Acts of Congress or Presidential Proclamations as National Rivers, National Wilderness Areas, National Seashores, National Lakeshores, National Parks, National Monuments, and such laws as may be established under Federal law for similar and related purposes, such as marine and estuarine sanctuaries (paragraphs 4.20, 4.22, and 4.23 of the EIS).

(6) Disposal of dredged material in coastal zones and marine sanctuaries. Not applicable since the State of South Carolina does not have a coastal zone management plan approved by the Secretary of Commerce and the project area is not within a marine sanctuary established by the Secretary of Commerce.

f. Evaluation [illegible] in this paragraph [illegible] for this project (Section 9.0 and Appendix C [illegible] paragraphs 34, 35, 50, and 69 and Exhibits 1-17 [illegible] the GDM).

g. Public [illegible] coordination [illegible]

EPA Guidelines, Discharge of Dredged or Fill Material in Navigable Waters

a. (40 CFR 230)

(1) [illegible]

(a) [illegible] 5,750,000 cubic yards of material [illegible] construction. All of this [illegible] and fill construction, beach nourishment [illegible] the periodic removal of [illegible] 309,000 cubic yards. All [illegible] be used for nourishment of adjacent beaches.

[illegible] material [illegible] discussed above, large quarry-[illegible] jetties. The upcoast jetty would be [illegible] the downcoast jetty 3,490 feet long. The maximum [illegible] would be 15 feet and the maximum bottom width [illegible] would provide substrate and cover for a variety [illegible] would support a jetty related sport fishery [illegible] available in the area (paragraph 4.13 of the EIS).

[illegible] in the immediate area of fill would be destroyed. [illegible] significant or permanent impairment of the water [illegible] all of the proposed work (see paragraph 1.04-1.08, 1.13-1.3, 4.0) and 4.01 of the EIS and paragraphs 65, 66, 103-109 and 142 of the GDM).

(b) (1) (a) (ii) Ecological interactive effects. Since the materials to be used are either from the immediate area or consist of large quarry-stone, they qualify for exclusion from the evaluative procedures specified in paragraphs (f)(2) and (3). (See paragraph 4.15 and Appendix B of the EIS.)

c. Comparison of excavated and fill material with the disposal site. The excavated material is of the same consistency and constituency as the area into which it will be placed and the quarrystone is compatible with the sediments upon which it will be placed (paragraphs 53-62 and Appendix C of the GDM and Appendix B of the EIS).

230.4-2 Water quality considerations. Construction and operation and maintenance of the Little River Inlet navigation project would not result in contravention of any State, interstate, or local water quality

drift patterns so that the project would not cause erosion of any beaches in the area (paragraph 4.13, 4.23, and 4.29 of the EIS).

There would be no eutrophication, degradation of aesthetic values or impediment of recreation uses due to release of nutrients from dredged or fill material (paragraph 4.01 of the EIS).

(6) Threatened and endangered species. The proposed project would not jeopardize the continued existence of threatened or endangered species or destroy or modify the habitat of those species determined critical in accordance with the Endangered Species Act (paragraph 4.20 of the EIS).

(7) Benthic life. Any benthic life in the disposal area would be smothered by deposition of dredged materials. This loss would not significantly affect the area's long-term productivity since animals in these areas characteristically undergo rapid population overturns and would be replaced by recruitment from adjacent areas (paragraph 4.15 of the EIS). The jetties would provide substrate and cover for a variety of plant and animal life (paragraph 4.13 of the EIS).

(8) Wetlands. Utilizing excess dredged materials for beach nourishment above mean low water is the most beneficial disposal alternative. Disposal in these wetlands would not have an unacceptable adverse impact on aquatic resources. The proposed fill and the activity associated with it will not cause a permanent unacceptable disruption to the beneficial water quality uses of the affected aquatic ecosystem (paragraphs 4.15 and 4.18).

(9) Submersed vegetation. No areas of submersed vegetation would be destroyed or adversely affected by the proposed action.

(10) Size of the disposal area. The size of the proposed disposal areas is the smallest practicable to perform the design functions of this project.

(11) Contaminated fill material restrictions. There will be no deposition, discharge, leaching, or erosion of contaminated material associated with this project (paragraph 4.01 and Appendix B of the EIS).

(12) Mixing zone determination. Not applicable.

END

FILMED

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DTIC